HOWARD'S

ART OF COMPUTATION,

AND

GOLDEN RULE

FOR

EQUATION OF PAYMENTS.

ONE DOLLAR.

C. Frusher Howard

HOWARD'S

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AND

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EQUATION OF PAYMENTS

FOR

SCHOOLS, BUSINESS COLLEGES

AND

SELF-CULTURE.

A NEW, CONCISE AND COMPREHENSIVE

TEACHER AND MANUAL

OF

BUSINESS ARITHMETIC.

BY THE AUTHOR OF THE CALIFORNIA CALCULATOR,

C. FRUSHER HOWARD,

SAN FRANCISCO.

1880.

The Author specially cautions all Book Pirates that his sole rights and title to the following original Rules and Tables are legally secured, and will be maintained against all infringements.

HOWARD'S Golden Rule for Equation of Payments.
" " " Averaging Accounts.
" " " Partial Payments.
Computing Interest on a Basis of one per cent.
" " by dividing the year by the rate.
" " Bank of England Rule.
Compound Interest.
Squaring numbers by their base and difference.
California Calendar for thirty centuries.
The original Tables and their arrangement.

PREFACE.

THE ability to make business calculations with ease, accuracy and rapidity, is an all-important acquisition to every class of the community. The methods of Arithmetic hitherto taught have been so abstruse and difficult as to deter all, but a small per centage, from giving the weary months and years of time, labor and study necessary to master its mysteries. WONDERFUL and STARTLING discoveries have RECENTLY been made and embodied in the following rules, simplifying and shortening all the operations of numbers, so as to make RAPID CALCULATION easy to all;

The rules taught in Schools are needlessly weighted with superfluous elements, that only serve to encumber the operations, and distract, and confuse the learner; the Rules here taught avoid all this, and by an easily learned, simple, and natural arrangement lead directly to the required answer.

They are especially adapted to that large class of persons who find it difficult, or impossible, mentally to grasp, and retain complex numbers; such persons will find in this book

"A Complete Teacher of Business Arithmetic"

all the examples being worked out, and explained so as to be readily understood, transforming the drudgery of calculation, into a pleasing pastime, and qualifying persons of ordinary intellect, to surpass the performances of the "Lightning Calculators" who have astonished mankind.

PREFACE.

The success achieved by the CALIFORNIA CALCULATOR encourages the hope that the ART OF COMPUTATION will soon be in every school, making ALL the Boys "*quick at figures.*" The more gifted and ambitious will become expert Mathematicians with greater facility if they are FIRST good calculators.

A knowledge of the SCIENCE of numbers is an invaluable acquisition to those who are capable of acquiring it; to do this not more than one person in a hundred has either the time, necessity, or mental capacity.

To Accountants, Brokers, Farmers, Traders and persons engaged in the ruder mechanical pursuits, a knowledge of the SCIENCE OF NUMBERS is of minor importance; SKILL in the ART OF COMPUTATION is absolutely indispensable; the business of this Book is by *new, original* and *easily acquired* methods to teach that ART, in accord with, yet distinct from the SCIENCE.

As a SCHOOL BOOK, its aim is to make the learner a GOOD CALCULATOR with the greatest possible economy of time and study; its preëminence consists in the brevity and clearness of the rules; by their use, Interest and other calculations may be made, easier than they can be copied from ordinary Tables.

The REFERENCE TABLES are very comprehensive and their arrangement simple and original.

The miscellaneous section is unique; it embraces almost every variety of BUSINESS CALCULATION, the work of finding the answer to each question is so expressed that it constitutes a formula for all similar examples.

One Reviewer of these Rules and Tables says:

"*Students, Teachers and Business Men* can no more afford to be without them than they can afford to travel by OX-TEAMS, now the RAILWAY spans the Continent."

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HOWARD'S

ART OF COMPUTATION.

DEFINITIONS AND SIGNS.

ARITHMETIC is the science of numbers, and the art of computing by figures.

ABSTRACT NUMBER.— An abstract number is a number used without reference to any particular object, as 9, 745, 9764.

ADDITION, the act of adding, opposed to subtraction.

AMOUNT.—The sum of principal and interest.

ALIQUOT.—An *aliquot part* of a number is such a part as will exactly divide that number.

AREA, the surface included within any given lines.

ARITHMETICAL SIGNS are characters indicating operations to be performed, and are indispensable for briefly and clearly stating a problem:

+, *plus*, and more, signifying addition;

—, *minus*, less, signifying subtraction;

$\times$, *multiplied by*, as $2 \times 2 = 4$;

$\div$ or : *divided by*, as $6 \div 3 = 2$, or $6 : 3 = 2$, or $\frac{6}{3} = 2$;

$=$, *equality*, or *is equal to*, as $6 + 2 \times 2 = 16$, and is read thus, "6 plus 2, multiplied by 2, equals 16";

$\overline{}$, or ( ) &c., the vinculum; used to shew that all the numbers united by it are to be considered as one; thus, $\overline{6 \times 4} + \overline{3 \times 2} + 1$ means the product of 6×4 is to be added to the product of 3×2, and the sum of the products to be added to 1.

$\sqrt{}$ 9, sign of the square root, read "the square root of 9";

4^2, sign of the square, read "the square of 4";

$\sqrt[3]{8}$, the cube root of 8. 8^3, the cube of 8.

An angle is the corner formed by two lines where they meet.

Base, the lower, or side upon which a figure stands; the foundation of a calculation.

Concrete number, used with reference to some particular object or quantity, as 640 acres, 500 dollars.

Circle, a plane figure comprehended by a single curved line, called its *circumference*, every part of which is equidistant from its center.

Circumference, the line that goes around a circle or sphere.

Cylinder, a body bounded by a uniformly curved surface, its ends being equal and parallel circles.

Cube, a solid body with six equal square sides. A product formed by multiplying any number twice by itself, as $4 \times 4 \times 4 = 64$, the *cube* of 4.

Cube Root is the number or quantity which twice multiplied into itself produces the number of which it is the root, thus 4 is the *cube root* of 64.

Currency, the current medium of trade authorized by government.

Division determines how many times any one number is contained in another.

Discount, the sum deducted from an account, note, or bill of exchange, usually at some rate per cent.

Denominator, the number placed below the line in fractions, thus, in $\frac{7}{8}$ (seven-eighths) 8 is the *denominator.*

Decimal, a tenth; a fraction having some power of 10 for its denominator.

Decimal Currency is a currency whose denominations increase or decrease in a ten-fold ratio.

Dividend, the number to be *divided.*

Divisor, the number by which the *dividend* is to be *divided.* A *common divisor*, is a number that will *divide* two or more numbers without a remainder.

Diameter, a right line passing through any object.

Duodecimals are the divisions and subdivisions

of a unit, resulting from continually dividing by 12, as 1, $\frac{1}{12}$, $\frac{1}{144}$, $\frac{1}{1728}$, etc.

EXCHANGE, the receiving or paying of money in one place for its value in another, by order, draft, or bill of exchange.

FRACTION, part or parts of a whole number or unit, thus $\frac{3}{4}$, three-fourths, $\frac{1}{5}$, one-fifth.

An *improper fraction* is a fraction whose *numerator* exceeds its *denominator.*

FACTORS, numbers, from the multiplication of which proceeds the product; thus, 3 and 4 are the factors of 12.

FIGURE—A figure is a written sign representing a number.

INTEGER—An *integer* is a whole number or sum.

INTEREST, the price or sum per cent. derived from the use of money lent. *Simple interest* is that which arises from the principal sum only. *Compound interest* is that which arises from the *principal* and *interest* added—*interest* on *interest.*

MATHEMATICS, the science of quantities.

MULTIPLICATION, adding to zero any given number as many times as there are units in the *multiplier.*

MULTIPLIER, the number that *multiplies ;* the multiplier *must* be an abstract number.

MULTIPLICAND, the number *multiplied.*

MENSURATION is the art of measuring lengths, surfaces, and solids.

MULTIPLE, a quantity which contains another a certain number of times without a remainder. A *common multiple* of two or more numbers contains each of them a certain number of times, exactly. The *least common multiple* is the *least* number that will do this; 12 is the *least common multiple* of 3 and 4.

NUMBER, a *number* is a unit, or a collection of units. A *prime number* is one that cannot be resolved, or separated into two or more integral factors.

NOTATION, writing numbers.

NUMERATION, reading numbers.

NUMERATOR, the number placed above the line, in fractions; thus, $\frac{5}{9}$ (five-ninths), five is the *numerator*.

POWER—A *power* is the product arising from multiplying a number by itself, or repeating it several times as a factor; thus, $3 \times 3 \times 3$, the product, 27, is a *power* of 3. The *exponent* of a *power* is the number denoting how many times the factor is repeated to produce the *power*, and is written thus: 2^1, 2^2, 2^3.

$2^1 = 2^1 = 2$, the first *power* of 2.

$2 \times 2 = 2^2 = 4$, the second *power* of 2.

$2 \times 2 \times 2 = 2^3 = 8$, the third *power* of 2.

PRINCIPAL, the sum lent on interest, or invested.

PER CENT., from *per centum*, signifying by the hundred; hence, 1 *per cent.* of anything is one-hundredth part of it, 2 *per cent.* is one-fiftieth, etc.

QUADRANGLE, the name of a figure with four sides.

QUANTITY is anything that can be increased, diminished, or measured.

RATIO, the quotient of one number divided by another.

RECIPROCAL is a unit divided by any number. The *reciprocal* of any number or fraction, is that number or fraction inverted; thus the *reciprocal* of $\frac{4}{1}$ is $\frac{1}{4}$, of $\frac{3}{4}$ is ,$\frac{4}{3}$ of $3\frac{1}{3}$ is $\frac{3}{10}$.

RATE PER CENT., the rate per hundred.

RULE—A *rule* is the prescribed method of performing an operation.

RADIUS, half the diameter of a circle. A right line passing from the center to the circumference.

SUBTRACTION is the process of finding the difference of two numbers by taking one number called the *subtrahend* from another number called the *minuend.*

SURFACE OR SUPERFICES, the exterior part of anything that has length and breadth.

SUPPLEMENT, the difference of a number and some particular number below it; thus 13, taking 10 as the base, the *supplement* is 3, because the difference of 13 and 10 is 3.

SQUARE, a figure having four equal sides, and four right angles. The product of a number

multiplied by itself; thus 16 is the square of 4. $4 \times 4 = 16$.

SQUARE ROOT is the number which multiplied into itself, produces the number of which it is the *root.* 4 is the *root* of 16; $4 \times 4 = 16$.

SPECIE, coin.

SCALE—A scale is a series of numbers regularly ascending or descending.

A SOLID or BODY has length, breadth and thickness.

SPHERE, a body in which every part of the surface is equally distant from the center.

TRIANGLE, a figure with three sides.

TERM—The *terms* of a fraction are numerator and denominator taken together.

UNIT—A unit is *one thing.*

VERTEX, the top of a pyramid or cone.

ZERO, a cipher, or nothing.

In arithmetic, the answer in each operation has a distinctive name. In addition it is called the *sum*; in subtraction, *difference* or *remainder;* in multiplication, the *product;* in division, the *quotient.*

NOTATION.

All numbers are represented by the ten following figures:

1, one.	2, two,	3, three,	4, four,	5, five,	6, six,	7, seven.	8, eight,	9, nine,	0. ciph'r.

To establish their significance clearly in the mind of the pupil it will be of great advantage occasionally to write and read them in the following manner:

$\frac{1}{1}$ one one	$\frac{2}{1}$ two-ones	$\frac{3}{1}$ three-ones	$\frac{4}{1}$ four-ones	$\frac{5}{1}$ five-ones	$\frac{6}{1}$ six-ones	$\frac{7}{1}$ seven-ones	$\frac{8}{1}$ eight-ones	$\frac{9}{1}$ nine-ones	$\frac{0}{1}$ no ones

The different values which the same figures have, are called *simple* and *local* values.

The *simple* value of a figure is the value it expresses when it stands alone, or in the right hand place.

The *local* value of a figure is the increased value which it expresses by having other figures placed on its right.

Ten is expressed by combining one and cipher, thus, 10; two and cipher combined make twenty, thus, 20, etc. A hundred is expressed by combining the one and two ciphers, thus, 100; two

hundred thus, 200, etc. Ten ones make a ten; ten tens make a hundred; ten hundreds make one thousand; that is, numbers increase from right to left in a ten-fold ratio. Each removal of a figure one place to the left increases its value ten times.

NUMERATION.

Tredecill'ns.	Duodecil'ns.	Undecilli'ns,	Decillions,	Nonillions,	Octillions,	Septillions,	Sextillions,	Quintillions,	Quadrilli'ns,	Trillions,	Billions,	Millions,	Thousands,	Units,
121,	227,	196,	497,	321,	415,	716,	219,	304,	196,	218,	316,	415,	207,	126.

To read numbers expressed by figures: Point them off into periods of three figures each, commencing at the right hand; then, beginning at left hand, read the figures of each period in the same manner as those of the right hand period are read, and at the end of each period pronounce its name; thus, 121 tredecillions, 227 duodecillions, 196 undecillions, 497 decillions, 321 nonillions, 415 octillions, 716 septillions, 219 sextillions, 304 quintillions, 196 quadrillions, 218 trillions, 316 billions, 415 millions, 207 thousands, 126.

ADDITION.

Various suggestions have been made referring to improved methods of addition. In nearly every case the proposed improvement has been more fanciful than real. In practice, I have found no better or quicker method than the following:

```
 3746
 8743
 6978
 1256
 3021
 ----
23744
```

Commence at the bottom of the right hand column; add thus, 7, 15, 18, 24; set down the 4 in unit's place, and carry the two tens to the second column; then add thus, 4, 9, 16, 24; set down the 4 in ten's place, and carry the two hundreds to the third column, and so on to the end. Never add in this manner: 1 and 6 are seven, and 8 are 15, and 3 are 18, and 6 are 24. It is just as easy to name the *sum* at once, omitting the name of each separate figure, and saves two thirds of time and labor.

Book-keepers and others who have long columns of figures to add will find the following methods and suggestions acceptable.

Rule of addition for two columns at once: first practice adding two columns of two figures each, until you are able to grasp at a glance, and pronounce their sum.

23	15	32	38	87	56
14	33	44	57	41	78
37	48	76	95	128	134

Add from the left, and say *three seven*, *four eight*, *twelve eight*, &c., &c., instead of *thirty-seven*, *forty-eight*, *one hundred and twenty-eight*, &c., &c.; this habit is readily acquired and saves half the time.

When you can instantly, at sight, name the sum of two pairs of figures, practice with gradually increasing columns of pairs, then take examples consisting of two or more columns of pairs.

	36			2147
	41			3472
47	74		*	1463
83	22		4614	2634
32	36	2123	7843	1785
21	41	4679	2183	6823
183	250	6802	14640	18324

* The process is *twelve six*, *one four* naught; the 40 is put down and the 1 carried to the units column in the next pair, then *ten naught*, *one four six*.

Any person who will PRACTICE this method, may add two columns with perfect ease; there is no royal road to this accomplishment: speed with precision can be attained only by persistent PRACTICE.

Fives are always easy to add; so are 9's, when it is borne in mind that adding 9 to a sum places it in the next higher ten with the unit 1 less; thus, $17 + 9 = 26$; $39 + 9 = 48$; $63 + 9 = 72$.

8
4
7^{2}
9
6
5
8
7
9
4
6
8
7
9
8
9

In adding long columns of figures, write in the margin, lightly with pencil, opposite the last figure added, the unit figure of the sum immediately exceeding 100. By doing this the mind is never burdened with numbers beyond 100; and if interrupted in the work, it can be resumed at the stage at which the interruption occurred. The example in the margin shows the method; opposite the figure 7; the 2 indicating the column, so far, with the 7 included, amounts to 102.

INSTANTANEOUS ADDITION BY COMBINATION.

Write two, three, four, or more rows of miscellaneous figures, then write such figures as will make an equal number of nines in each column; under these again, write another row of miscellaneous figures.

EXAMPLE—

4 9 8 7
4 7 3 6
2 1 8 7
5 0 1 2 one 9.
5 2 6 3 two 9's.
7 8 1 2 three 9's.
4 9 8 6
———
3 4 9 8 3*

RULE.—Bring down the last row, less the number of nines in each column, and prefix the number of nines.

* This example has three nines in each column.

Rule.—Write the numbers so that the units in the subtrahend shall be directly under the units of the same value in the minuend; under, and in the same order, write the difference.

Subtract 473 from 1694.

$$\begin{array}{r} 1694 \\ 473 \\ \hline 1221 \end{array}$$

To prove Subtraction, add the *difference* to the *subtrahend*; if correct, their sum = the *minuend*.

MULTIPLICATION.

The base of our system of notation is 10; therefore numbers increase and diminish in a tenfold ratio; increasing from the decimal point to the left, and decreasing from the decimal point to the right; hence to multiply any number by 10, annex a cipher, or remove the point one place to the right. To multiply any number by 100, annex two ciphers, or remove the point two places to the right. To multiply any number by 1000, annex three ciphers, or remove the point three places to the right.

To find the product of two numbers, when the multiplicand and the multiplier each contain but two figures.

Example 1—

$$\begin{array}{r} 33 \\ 22 \\ \hline 726 \end{array}$$

EXPLANATION—set down the smaller factor under the larger, units under units, tens under tens. Multiply the units of the multiplicand by the unit figure of the multiplier; thus, $2 \times 3 = 6$, set the 6 down in unit's place; multiply the tens in the multiplicand by the unit figure in the multiplier, and the units in the multiplicand by the tens figure in the multiplier; thus, $3 \times 2 = 6$, and $3 \times 2 = 6$, add these two products together; 6 and 6 are 12; set down 2, carrying the ten to the next product, then multiply the tens in the multiplicand by the tens in the multiplier; thus, $3 \times 2 = 6$; add the one carried from the last product, making the whole product 726.

The same method can be applied when the multiplicand has three or more figures.

EXAMPLE 2—

$$\begin{array}{r} 1\,6\,3 \\ 2\,4 \\ \hline 3\,9\,1\,2 \end{array}$$

The steps are: $3 \times 4 = 12$, set down the 2 and carry the 1; $(6 \times 4) + (3 \times 2) + 1 = 31$; set down the 1, and carry the 3. $(1 \times 4) + (6 \times 2) + 3 = 19$; set down 9 and carry 1; $1 \times 2 + 1 = 3$, which place at the head of the line, making a total of 3912.

When the multiplier can be resolved into two factors, it is sometimes shorter to multiply by each factor, than by the whole number.

EXAMPLE, multiply 163 by 24.

$8 \times 3 = 24.$

$$\begin{array}{r} 163 \\ 8 \\ \hline 1304 \\ 3 \\ \hline 3912 \end{array}$$ Ans.

When the multiplier is any number between 11 and 20, the process is simply to multiply by the unit of the multiplier, set down the product under, and one place to the right *of*, and then add *to* the *multiplicand.*

EXAMPLE, multiply 1496 by 17.

$$\begin{array}{l} 1496 \\ 10472 \\ \hline 25432 \end{array}$$ Ans.

or thus:

$$\begin{array}{r} 1496 \\ 17 \\ \hline 25432 \end{array}$$

The process in the last example is:

$6 \times 7 = 42$, set down 2 and carry 4.
$9 \times 7 + 6 + 4 = 73$; carry 7.
$4 \times 7 + 9 + 7 = 44$; carry 4.
$1 \times 7 + 4 + 4 = 15$; carry 1.
$1 + 1 = 2$.

To multiply two figures by 11.

RULE.—Between the two figures write their sum: thus: multiply 43 by 11. Ans. 473. The sum of

4 and 3 is 7; place the seven between the 4 and 3, for the product.

NOTE.—Add one to the hundreds when the sum exceeds 9.

To multiply any number by 11.

RULE—Bring down the extreme right hand figure, then add the right hand figure to the next, and bring down the sum; then add the second figure to the third and bring down the sum, adding in the figure carried, in each case, and so on to the end.

EXAMPLE—

$$\begin{array}{r} 12345678 \\ 11 \\ \hline 135802458 \end{array}$$

To multiply any two numbers ending with 5.

RULE.—Add ½ the sum of the figures preceding the 5 in each number to the product of the same figures, and annex 25.

NOTE.—When the sum of the preceding figures is an odd number, add half the number next smaller than the sum and annex 75.

Multiply 85 by 65 and 105 by 35.

$85\times65=7+\overline{8\times6}$ with 25 annexed $=5525$

$105\times35=6+\overline{10\times3}$ " 75 " $=3675$

To multiply when the unit figures added, equal 10, *and the tens are alike, as* 67 × 63.

RULE.—Multiply the units and set down the result, then add one to the upper number in tens place, and multiply by the lower.

To multiply unlike numbers greater than a common base.

RULE.—To the common base add the differences; multiply the sum by the base and add the product of the differences.

EXAMPLE.—Multiply 603 by 612

$$\overline{603+12}\times 600+\overline{3\times 12}-369,036.$$

To multiply unlike numbers less than a common base.

RULE.—To the multiplicand add the tens and units of the multiplier, less the last 1 to carry, multiply the sum by the common base and add the product of the differences.

EXAMPLE.—Multiply 93 by 89 and 293 by 289.

$$\begin{array}{r} 89 \\ 93 \\ \hline 8277 \end{array} \qquad \begin{array}{l} \;\;293 \\ \;\;\;\;89 \\ \hline 282\times 300+\overline{11\times 7}=84,677. \end{array}$$

The product of any two numbers=the square of their mean, diminished by the square of half their difference.

EXAMPLE.—Multiply 22 by 18.

$$20^2—2^2 = 396.$$

To multiply two numbers having a common base, one ending with 25, *the other ending with* 75.

RULE.—Multiply the common base by one more than itself and annex 1875.

EXAMPLE.—Multiply 675 by 625.

6×7 with 1875 annexed=421,875.

To multiply two numbers when either has one or more ciphers on the right, as 26 *by* 20, 244 *by* 200, *etc.*

RULE.—Take the cipher or ciphers from one number and annex it, or them, to the other, multiply by the number expressed by the remaining figures.

EXAMPLE 1.—Multiply 26 by 20. Ans. 520.

Process.—$260 \times 2 = 520$.

2.—Multiply 244 by 200. Ans. 48800.

$24400 \times 2 = 48800$.

RAPID METHOD OF SQUARING NUMBERS.

BY THE DIFFERENCE OF A NUMBER AND ITS BASE.

For squaring a number greater than its base.

RULE.—To the given number add the difference, multiply the sum by the base; to the product add the square of the difference.

NOTE. Take the nearest convenient multiple of ten for the base.

EXAMPLE 1.—What is the square of 11? Ans. 121.

Process.—Taking 10 for the base, the difference is one $(1 + 11) \times 10 + 1^2 = 121$.

NOTE. Until this rule is thoroughly understood, the learner should limit his exercises to numbers near 10, 100, 1000, &c.; and then operate with more complex numbers.

1. $(22)^2 = 484$.

Process.—Taking 20 for the base, the difference $(2 + 22) \times 20 + 2^2 = 484$.

2.— $(33)^2 =$ 1089

For squaring numbers less than the base.

RULE.—From the number to be squared *subtract* the difference, *multiply* the result by the base, to the product *add* the square of the difference.

$$1.\ (9)^2 = 81.$$

Process.—Taking 10 for the base, the difference or complement is 1, then $(9-1) \times 10 + 1^2 = 81$.

NOTE. In squaring numbers between 50 and 60, take 50 for the base; to 25 add the difference, call the sum hundreds, to this add the square of the difference.

1.—$(51)^2 = 2601$.
Process.—$25 + 1 = 2600 + 1^2 \times = 2601$.
2.—$(52)^2 = 2704$.

NOTE. In squaring numbers between 40 and 50; to 15 add the unit figure, call the number hundreds, to the sum add the square of the difference, taking 50 for the base.

1.—$(41)^2 = 1681$.
Process.—$15 + 1 = 1600 + 9^2 = 1681$.
2.—$(42)^2 = 1764$.
3.—$(43)^2 = 1849$.

By this rule the squares of all numbers up to 1000, and larger numbers near the multiples of 10 may be found with less labor than is required to find them in tables;

The square of any number ending with 25=half the number of hundreds + the square of the number of hundreds$\times$10,000+625.

$$3+6^2\times 10{,}000+25^2=390{,}625=625^2$$

In squaring very high numbers, use the foregoing rule in connection with the following formula:

"The square of any number=the sum of the squares of its parts, plus twice the product of each part by the sum of all the others."

EXAMPLE.—Find the square of 823,732

$$
\begin{array}{rr}
823{,}000^2= & 677{,}329{,}000{,}000 \\
823{,}000\times732\times2= & 1{,}204{,}872{,}000 \\
732^2= & 535{,}824 \\
\hline
 & 678{,}534{,}407{,}824
\end{array}
$$

When either the tens or the units are alike.

RULE.—Multiply the units, set down the unit figure of the product; multiply the sum of the unlike figures by one of the like figures, then multiply the tens figures together, adding the carrying figures as you proceed.

Multiply 92 by 97 and 74 by 24.

$$
\begin{array}{r}
97 \\
92 \\
\hline
8924
\end{array}
\qquad\qquad
\begin{array}{r}
74 \\
24 \\
\hline
1776
\end{array}
$$

When the units are alike and the sum of the tens is ten.

RULE.—Add one of the units to the product of the tens, and annex the product of the units.

Multiply 74 by 34.

$\overline{7\times3}+4$ with 16 annexed$=2516$.

To multiply any two numbers between 10 *and* 20.

RULE.—To the product of the units prefix 1, and add the sum of the units calling it tens.

Multiply 18 by 14.

8×4 with 1 prefixed$=132$. $132+12$ tens, $=252$.

When the multiplier is a number near, and less, than a multiple of 10.

Rule.—Annex to the multiplicand as many ciphers as there are in the next order of tens higher than the multiplier, subtract the product of the multiplicand by the complement.

Multiply 222 by 93.

$$22{,}200-\overline{222\times7}=20{,}646.$$

When both numbers have a cipher in the tens place.

Rule.—Write the product of the units, then the sum of the products of the upper hundreds by the lower units, and the lower hundreds by the upper units, prefix the product of the hundreds.

Multiply 409 by 704.

$$\begin{array}{r} 704 \\ 409 \\ \hline 287936 \end{array}$$

DIVISION.

Division is the process of finding how many times one number or quantity is contained in another.

Rule.—To the left and in a line with the *dividend*, write the *divisor*, separated by an arc. Take so much of the dividend as contains a number less than ten times the *divisor;* the number of times the *divisor* is contained in that part of the *dividend* is the first figure in the quotient; annex the next unused figure of the *dividend* to the *remainder* to find the second figure of the quotient, and so on to the end.

Divide 49654809 by 4.

$$\begin{array}{r} 4)\underline{49654809} \\ \text{Ans. } 12413702\tfrac{1}{4} \end{array}$$

Process—The *divisor* 4 is contained in the first figure of the *dividend* once, therefore 1 is the first figure in the *quotient*: 4 is contained twice and 1 remainder in 9; 2 is then the second figure in the quotient: the next unused figure 6 annexed to the remainder 1=16: 4 is contained in 16 four times, and so on to the end.

Divide 7983204 by 23.

$$\begin{array}{l} 23)7983204(347095\tfrac{19}{23} \\ \quad\;\; \overline{108} \\ \quad\;\;\; \overline{163} \\ \quad\;\;\;\; \overline{220} \\ \quad\;\;\;\;\; \overline{134} \\ \quad\;\;\;\;\;\; \overline{19} \end{array}$$

Process. $79-\overline{23\times3}$, the remainder is 10; the next unused figure in the *dividend* 8, annexed to $10=108$; $108-\overline{23\times4}$, the remainder is 16; to this remainder annex the next unused figure in the dividend, and so on until the quotient is complete. When the divisor is a composite number, divide by its factors.

EXAMPLE.—Divide 504 by 42. $42=7\times6$.

$$\begin{array}{r|l} 6 & 504 \\ 7 & \overline{\;84} \\ & \overline{\;12} \text{ Ans.} \end{array}$$

FRACTIONS.

GENERAL PRINCIPLES OF FRACTIONS.

Multiplying the numerator, multiplies the fraction.

Dividing the numerator, divides the fraction.

Multiplying the denominator, divides the fraction.

Dividing the denominator, multiplies the fraction.

Multiplying or *dividing* both terms of the fraction by the same number, does not change its value.

Fractions are called similar when they have a common denominator, as $\frac{4}{5}$, $\frac{3}{5}$, $\frac{2}{5}$, $\frac{1}{5}$.

Dissimilar fractions are fractions that are not alike, as $\frac{3}{9}$, $\frac{4}{7}$, $\frac{2}{5}$, $\frac{7}{8}$.

The numerators of similar fractions only can be added.

The common denominator is written under the sum or difference.

To reduce a fraction to its simplest form.

RULE.—Divide both terms by their greatest common divisor or its factors, the simplest form, or lowest term of $\frac{36}{48}$, is obtained by dividing both terms by 12, $\frac{36}{48} = \frac{3}{4}$.

To find the greatest common divisor of two numbers:

RULE.—Divide the greater by the less, and the previous divisor by the remainder, and so on until there is no remainder; the last divisor is the answer.

Find the greatest common divisor of 18 and 27.

$$\begin{array}{l} 18)27(1 \\ \quad\;\; 18 \\ \hline \quad\;\; 9)18(2 \\ \qquad\;\; 18 \end{array}$$

Ans. 9.

To find the least common multiple:

RULE.—Cancel all the numbers that are contained in any of the others; divide all those not canceled by any number, or the *greatest* of its factors, that will exactly divide any one of them, bring down each quotient with the undivided numbers and proceed as before, until no two numbers have a common divisor; the product of all the divisors and the remaining numbers is the answer.

Find the least common multiple of 36, 8, 9, 10, 12, 25, 84, 75. Ans. $12 \times 3 \times 2 \times 7 \times 25 = 12600$.

$$\begin{array}{l} 12\underline{)36,\ 8,\ \cancel{9},\ 10,\ \cancel{12},\ \cancel{25},\ 84,\ 75} \\ \quad\;\; 3,\ 2,\quad\ \cancel{5},\qquad\qquad\ 7,\ 25 \end{array}$$

ADDITION OF FRACTIONS.

RULE.—Make the fractions similar by reducing them to the same denominator; add the numerators, and place the sum over the common denominator.

1. What is the sum of $\frac{2}{3}$ and $\frac{1}{4}$? Ans. $\frac{11}{12}$.
2. What is the sum of $\frac{3}{5}$ and $\frac{1}{2}$? Ans. $1\frac{1}{10}$.

SUBTRACTION OF FRACTIONS.

RULE.—Make the fractions similar by reducing them to the same denominator, and write the difference of the numerators over the common denominator.

1. From $\frac{3}{4}$ take $\frac{1}{2}$. Ans. $\frac{1}{4}$.

Process, $\frac{1}{2} = \frac{2}{4}$, $\frac{3}{4} - \frac{2}{4} = \frac{1}{4}$.

2. From $9\frac{1}{3}$ take $4\frac{1}{2}$. Ans. $4\frac{5}{6}$.
3. From $8\frac{1}{2}$ take $3\frac{1}{4}$. Ans. $5\frac{1}{4}$.
4. From $18\frac{3}{4}$ take $3\frac{1}{3}$. Ans. $15\frac{5}{12}$.

MULTIPLICATION OF FRACTIONS.

RULE.—Multiply the numerators together for a new numerator, and the denominators together for a new denominator.

EXAMPLE.—Multiply $\frac{7}{8}$ by $\frac{2}{5}$.

$$\frac{7}{8} \times \frac{2}{5} = \frac{14}{40} = \frac{7}{20}.$$

General rule for multiplying fractions and all mixed numbers.

RULE.—Multiply the whole numbers together, then multiply the upper whole number by the lower fraction, then multiply the upper fraction by the lower whole number, then multiply the fractions together, and add all the products together.

1. Multiply $8\frac{1}{2}$ by $4\frac{1}{3}$. Ans. $36\frac{5}{6}$.

When the multiplier, or divisor is an aliquot part of 100 *or* 1000, *the process may be shortened by the use of the*

TABLE OF ALIQUOT PARTS.

$12\frac{1}{2}$ is $\frac{1}{8}$ part of 100.	$8\frac{1}{3}$ is $\frac{1}{12}$ part of 100
25 is $\frac{2}{8}$ or $\frac{1}{4}$ of 100.	$16\frac{2}{3}$ is $\frac{2}{12}$ or $\frac{1}{6}$ of 100
$37\frac{1}{2}$ is $\frac{3}{8}$ part of 100.	$33\frac{1}{3}$ is $\frac{4}{12}$ or $\frac{1}{3}$ of 100
50 is $\frac{4}{8}$ or $\frac{1}{2}$ of 100.	$66\frac{2}{3}$ is $\frac{8}{12}$ or $\frac{2}{3}$ of 100
$62\frac{1}{2}$ is $\frac{5}{8}$ part of 100.	$83\frac{1}{3}$ is $\frac{10}{12}$ or $\frac{5}{6}$ of 100
75 is $\frac{6}{8}$ or $\frac{3}{4}$ of 100.	125 is $\frac{1}{8}$ part of 1000
$87\frac{1}{2}$ is $\frac{7}{8}$ part of 100.	250 is $\frac{2}{8}$ or $\frac{1}{4}$ of 1000
$6\frac{1}{4}$ is $\frac{1}{16}$ part of 100.	375 is $\frac{3}{8}$ part of 1000
$18\frac{3}{4}$ is $\frac{3}{16}$ part of 100.	625 is $\frac{5}{8}$ part of 1000
$31\frac{1}{4}$ is $\frac{5}{16}$ part of 100.	875 is $\frac{7}{8}$ part of 1000

To multiply by the aliquot part of 100.

NOTE.—If the multiplicand is a mixed number, reduce the fraction to a decimal.

RULE.—Multiply by 100, by annexing two ciphers; such part of the product as the multiplier is part of 100 will be the answer.

EXAMPLE.—Multiply 86 by $12\frac{1}{2}$. Ans. 1075.

To divide by the aliquot part of 100 *or* 1000.

RULE.—Reduce the fraction, if any, to a decimal, remove the point two places to the left for 100, three places for 1000 and multiply the quotient by the part the divisor is of 100 or 1000.

$$47825 \div 100 \times 8 = 47825 \div 12\tfrac{1}{2} = 3826.$$

To multiply any two numbers together, ending with $\frac{1}{2}$*, as* $9\frac{1}{2}$ *by* $3\frac{1}{2}$.

Rule.—To the product of the whole numbers, add half their sum, plus $\frac{1}{4}$.

Note. When the *sum* is an odd number take half the next number below it, and the fraction in the answer will be $\frac{3}{4}$.

1. What will $9\frac{1}{2}$ lbs. of rice cost, at $3\frac{1}{2}$ cts. per lb? Ans. $33\frac{1}{4}$ cents.

Process.—The sum of 9 and 3 is 12; half this sum is 6; then we say 9 times 3 is 27, and 6 = 33; to this add $\frac{1}{4}$.

2. What will $9\frac{1}{2}$ doz. buttons cost, at $8\frac{1}{2}$ cts. per doz? Ans. $80\frac{3}{4}$ cts.

3. What will $11\frac{1}{2}$ lbs. of beef cost, at $9\frac{1}{2}$ cents per lb? Ans. \$1.09$\frac{1}{4}$.

4. What will $7\frac{1}{2}$ doz. eggs cost, at $13\frac{1}{2}$ cents per doz? Ans. \$1.01$\frac{1}{4}$.

To multiply any two numbers together having the same fraction.

Rule.—To the product of the whole numbers, add the product of their sum by the fraction; to this add the product of the fractions.

1. What will $13\frac{3}{4}$ lbs. of beef cost, at $7\frac{3}{4}$ cents per lb? Ans. \$1.06$\frac{9}{16}$.

Process.—The sum of 13 and 7 is 20, three-fourths of this sum is 15, so we say, 7 times 13 is 91, and 15 = 106, to which add the product of the fractions, ($\frac{9}{16}$) and the result is the Ans. \$1.06$\frac{9}{16}$.

In actual business calculations, any fraction *less* than a cent is reckoned as *one* cent; therefore in dealing with such questions as $13\frac{1}{3}$ pounds of beef at $7\frac{1}{5}$ cents a pound, it is sufficiently accurate to say:

$\frac{1}{5}$ of $13=3$. $\frac{1}{3}$ of $7=2$. $\overline{13\times7}+3+2=96$ cents;

Or $17\frac{1}{4}$ lbs. of cheese at $9\frac{1}{3}$ cents per pound.

$\frac{1}{3}$ of $17=6$. $\frac{1}{4}$ of $9=2$. $\overline{17\times9}+6+2=\$1.61$.

When the whole numbers are alike, and the sum of the fractions is a unit.

RULE.—Take the *product* of the whole numbers, to this add the *integer* in the multiplicand, then add the *product* of the fractions, and the result will be the answer.

1. Multiply $2\frac{1}{2}$ by $2\frac{1}{2}$. Ans. $6\frac{1}{4}$.

Process—$2 \times 2 + 2 = 6 + \frac{1}{2} \times \frac{1}{2} = 6\frac{1}{4}$.

2. $3\frac{1}{3} \times$ by $3\frac{2}{3} = 12\frac{2}{9}$.
3. $7\frac{7}{8} \times 7\frac{1}{8} = 56\frac{7}{64}$.
4. $9\frac{5}{8} \times 9\frac{3}{8} = 90\frac{15}{64}$.
5. $19\frac{5}{8} \times 19\frac{3}{8} = 380\frac{15}{64}$
6. $101\frac{4}{5} \times 101\frac{1}{5} = 10302\frac{4}{25}$.
7. $109\frac{9}{13} \times 109\frac{4}{13} = 11990\frac{36}{169}$.
8. $98\frac{9}{14} \times 98\frac{5}{14} = 9702\frac{45}{196}$.
9. $96\frac{7}{9} \times 96\frac{2}{9} = 9312\frac{14}{81}$.
10. $9947\frac{11}{17} \times 9947\frac{6}{17} = 98952756\frac{66}{289}$.
11. $99957\frac{28}{37} \times 99957\frac{9}{37} = 9,991,501,806\frac{252}{1369}$.

DIVISION OF FRACTIONS.

RULE.—Reduce whole and mixed numbers to the form of an improper fraction. Multiply the dividend by the divisor inverted.

Divide 8 by $1\frac{1}{4}$. Ans. $6\frac{2}{5}$.

Process—$1\frac{1}{4}$ inverted is $\frac{4}{5}$. $\frac{4}{5}\times\frac{8}{1}=\frac{32}{5}=6\frac{2}{5}$.

To divide by any number expressed by 1 and any number of ciphers, remove the decimal point as many places to the left as there are ciphers in the divisor.

$74864 \div 1000 = 74.864$

DECIMALS.

The system of Decimal fractions is so pre-eminently simple, that when it is generally understood it will entirely displace the clumsy system of common fractions. In harmony with our system of notation, it is a fraction always having some power of ten for a denominator: thus $.1 = \frac{1}{10}$, $.03 = \frac{3}{100}$, $.007 = \frac{7}{1000}$, $47.8 = 47\frac{8}{10}$, &c., &c.

Where common fractions occur the calculation may be often simplified by reducing them to decimals. To reduce a common fraction to a decimal.

RULE.—*Divide the numerator by the denominator.*

$\frac{1}{2} = .5$	$\frac{1}{4} = .25$	$\frac{1}{8} = .125$	$\frac{1}{16} = .0625.$	
$\frac{3}{4} = .75$	$\frac{1}{3} = .33^{33}$	$\frac{2}{3} = .66^{66}$	$\frac{1}{5} = .2$	$\frac{2}{5} = .4$
$\frac{4}{5} = .8$	$\frac{3}{5} = .6$	$\frac{1}{6} = .16^{66}$	$\frac{1}{9} = .11^{11}$	$\frac{1}{12} = .083^{33}$

ADDITION AND SUBTRACTION OF DECIMALS

Are performed in the same manner as in whole numbers; care being taken to properly point off the decimal places.

MULTIPLICATION OF DECIMALS.

Rule.—Multiply as in whole numbers, and point off as many places to the left for decimals as there are decimal places in both factors.

1. Multiply .5 by .5. Ans. .25.
2. Multiply 1.75 by .3. Ans. .525.
3. 27.46 by .4 Ans. 10.984

To multiply by .1 remove the decimal point *one* place to the *left*, by .01 *two* places, by .001 *three* places, by 10 *one* place to the right, by 100 *two* places, by 1000 *three* places, &c, &c.

Note.—In practical business the answer to *three* decimal places is sufficiently exact, the *third* decimal only counting for mills, the drudgery of finding, and writing the figures for decimals of no value, may be avoided by reversing the order of the multiplier and writing the first figure of the reversed multiplier under the third decimal figure in the multiplicand, begin each line of the partial products, with the product of the multiplying figure and the figure directly above it, adding the carrying figure, if any, from the immediate right hand figure.

What is the par value in American gold coin of £11 ,, 4 ,, 3, Sterling?

£11.2125	11.2125
4.8665	56 684
560625	44 850
672750	8 970
672750	673
897000	67
448500	5
$54.56563125	$54.565

This example illustrates the difference of the two methods.

When there are not as many figures in the product as there are decimals in both factors, supply the deficiency by prefixing ciphers.

1. Multiply .3 by .3. Ans. .09.
2. Multiply .29 by .004. Ans. .00116.

DIVISION OF DECIMALS.

The division of decimals is performed in the same manner as in whole numbers, care being taken to point off the decimal places in the quotient.

RULE.—Divide as in whole numbers, and point off in the quotient as many places to the left for decimals as the decimal places in the dividend exceed those in the divisor.

Divide .244 by .4. Ans. .61.
Divide .255 by .05. Ans. 5.1.

The learner can supply additional examples at discretion, bearing in mind the following: The *dividend* must always contain, at least, as many decimal places as the *divisor*. When the number of figures in the quotient is less than the excess of the decimal places in the *dividend* over those in the *divisor*, the deficiency must be supplied by prefixing ciphers. When there is a remainder after dividing the dividend, annex ciphers, and continue the division; the ciphers annexed are decimals to the dividend.

When the divisor is a quantity a little less than a number expressed by 1 *and one or more ciphers:*

RULE.—Divide by the nearest higher number expressed by unity and one or more ciphers; multiply the quotient by the difference of the assumed and the given divisor, writing the product under, and as many places to the right, as there are significant figures in the given divisor; repeat this operation with each succeeding quotient as often, and to as many decimal places as the answer requires; the sum of the quotients is the answer.

EXAMPLE—Divide 126486568 by 99000.

```
1264.86568
  12.64865
    .12648
    126
      1
----------
1277.64208 Ans.
```

The answer to this example may be found by removing the point three places to the left and dividing by 9×11.

```
 9 | 126486.568
   |-----------
11 |  14054.0631
   |-----------
   |   1277.6421
```

The labor of finding the answer to valueless decimals may be saved by cutting off a figure from the right hand of the divisor, as each new figure in the quotient is found, carrying what would have been obtained by the multiplication of the figure cut off, 1 if the multiplication produces more than 5 and less than 15, 2 if more than 15 and less than 25, etc.

```
73.412)648.7654386(8.8373        73.412)648.7654386(8.8373
       587.296                           587.296
       -------                           -------
        61469|4                            61469
        58729|6                            58730
        -----                              -----
         2739|83                            2739
         2202|36                            2202
         ----                               ----
          537|478                            537
          513|884                            514
          ---                                ---
           23|5946                            23
           22|0236                            22
           --                                 --
            1|5740                             1
```

PROPORTION.

Proportion is the equality of ratios.

Ratio is the relation which one quantity bears to another of the same kind, with reference to the number of times that the one is contained in the other.

Thus, the ratio of 7 to 21 is 3, because 7 is contained 3 times in 21, or 21 is 3 times seven. The same result is obtained if we divide 7 by 21, for we then find $\frac{7}{21} = \frac{1}{3}$, which means that 7 is $\frac{1}{3}$ of 21, and this expresses the very same relation as before, to say that 7 is $\frac{1}{3}$ of 21 is precisely the same as to say that 21 is 3 times 7. The ratio of 9 to 27 is 3, but we have seen that the ratio of 7 to 21 is also 3, therefore, the ratios of 7 to 21 and 9 to 27 are the same, $21 \div 7 = 27 \div 9$, and these quantities are thefore called proportionals.

In any proportion, as

$$7 : 21 :: 9 : 27$$

the product of the middle numbers, 21 and 9, equals the product of the extremes, 7 and 27; hence the *rule*, that when the fourth proportional is unknown,

Multiply the second and third terms, and divide the product by the first.

Example.—If 7 sheep cost 21 dollars, what will 9 cost at the same rate? 27 dollars, Ans.

2d term, 21
3d term, 9

1st term, 7)189

27

Or thus, $\dfrac{\overset{3}{\cancel{21}} \times 9}{\cancel{7}} = 27$

Proportion is so much used in business, and may be simplified and shortened so much by the foregoing process of cancellation, that the pupil *must* learn both before he can hope to be expert with business calculations.

CANCEL ING IN CALCULATION.—Whenever it is reqnired to multiply two or more numbers together, and divide by a third, the first step is to state the problem in its most manageable form; this can only be done by the use of the arithmetical signs.

The statement $\dfrac{28 \times 12}{14}$

is to be read, 28 multiplied by 12 is to be divided by 14.

Stating the problem as above we see at a glance if the divisor is contained, and how many times, in either of the multipliers.

In the foregoing example the divisor, 14, is contained twice in the multiplier, 28; then cancel the 14 and substitute 2 for the 28, and say, twice 12 is 24 the answer.

Process, $\dfrac{\overset{2}{\cancel{28}} \times 12}{\cancel{14}} = 24.$

EXAMPLE.—If 9 turkeys cost \$18, what will be the cost of 27?

$$\frac{18 \times \overset{3}{\cancel{27}}}{\cancel{9}} = \$54, \text{ Answer.}$$

If the divisor is not contained evenly in either of the multipliers, there may be a common divisor for the divisor itself and one of the multipliers; if so, the common divisor may be used in canceling, thus:

$$\frac{\overset{7}{\cancel{63}} \times 8}{\underset{3}{\cancel{27}}} = 18\tfrac{2}{3}, \text{ Ans.}$$

A glance shows that 9 is the common divisor for 63 and 27.

When a common divisor has been used to change the expression of the divisor and one of the multipliers, the new divisor may be canceled when it is contained an even number of times in the other multiplier.

EXAMPLE—

$$\frac{\overset{7}{\cancel{63}} \times \overset{2}{\cancel{8}}}{\cancel{36} \quad \cancel{4}} = 14.$$

Process—36 and 63 divided by 9, the common divisor, becomes 4 and 7 respectively, the 4 into 8, 2 times, cancel 4 and 8, and twice 7 is 14, the answer.

Summary of the rapid process for *cancel ing.*

1. Draw a horizontal line; above the line write dividends only; below the line write divisors only.

2. If there are ciphers above and below the line, erase an equal number on either side; 1 standing alone may be disregarded.

3. If the *same* number stands above and below the line, erase them *both.*

4. If any number on either side of the line will divide any number on the other side of the line without a remainder, divide, and erase the two numbers, retaining the quotient figure on the side of the larger number.

5. If any two numbers on either side have a common divisor, divide them by that number, and retain the quotients only.

6. Multiply all the numbers above the line for a dividend, and those below the line for a divisor; divide, and the quotient is the answer.

7. Write all the terms of the same kind in units, or fractions, of the same denomination; *i. e.*, feet, or fractions of a foot; yards, or fractions of a yard.

EXAMPLE.—If 7 inches of velvet cloth cost $2\frac{1}{2}$ dollars, what will be the cost of 7 yards? $90, Ans.

Process, $$\frac{5}{\cancel{2}} \times \frac{\cancel{7}}{1} \times \frac{\overset{18}{\cancel{36}}}{\cancel{7}} = 90.$$

NOTE.—$2\frac{1}{2}$ dollars $= \frac{5}{2}$, 7 yards $= \frac{7}{1}$, 7 inches $=$ $\frac{7}{36}$ of a yard, $\frac{7}{36}$ inverted is $\frac{36}{7}$.

If an upright line is used put dividends on the right, and divisors on the left. In stating a question put the term of the same kind as the required term first, at the top, on the right of the line; then the other terms in pairs of the same kind; if the effect is to increase the answer, put the larger term on the right, and *vice versâ.*

EXAMPLE:—If 5 compositors, in 16 days of 14 hours long, can compose 20 sheets of 24 pages in each sheet, 50 lines in a page, and 40 letters in a line, in how many days of 7 hours long may 10 compositors compose a volume containing 40 sheets, 16 pages in a sheet, 60 lines in a page, and 50 letters in a line, 1 of the second set of compositors being equal to 2 of the first? Ans. 16 days.

Days		16	required term.
Compositors .	10	5	less time with 10 than 5 men.
Hours	7	14	more days with 7 than 14 hours a day.
Sheets	20	40	more time to set 40 than 20 sheets.
Pages	24	16	less time to set 16 than 24 pages.
Lines	50	60	more time to set 60 than 50 lines.
Letters	40	50	more time to set 50 than 40 letters.
Ratio	2	1	

NOTE.—Excepting the upper term 16, the numbers on one side exactly balance the numbers on the other, and may all be canceled.

This method acts like a pair of scales, we use known to find the value of unknown quantities; the arrangement of the terms is so very plain and natural as to be easily apprehended; by its use the most complex problems are simplified, and all business calculations made with very few figures, and very little mental effort; it is accurate, and free from the risk of error.

To compute Interest by Cancellation.

1st, on the right of the line write the principal, the time in days, and the rate per cent.

2nd, on the left the number of days, or its factors, in the year, and remove the decimal point two places to the left.

Find the interest on £428.10 for 146 days at 5 per cent. per annum of 365 days.

$$\left.\begin{array}{r|l} \cancel{73} & 42.85 \\ & \cancel{146}\ \ 2 \\ \cancel{5} & \cancel{5} \end{array}\right\} = 8.57 \quad = \quad £8,,11,,5.$$

Find the interest on \$99 for 23 days at 4 per cent. per annum of 360 days.

$$\left.\begin{array}{r|l} \cancel{9} & \cancel{99}\ \ 11 \\ \cancel{4} & \cancel{4} \\ 10 & 23 \end{array}\right\} = .253 \ = \ 25 \text{ cents, } 3 \text{ mills.}$$

In computing interest at rates per cent. per month, write principal, time and rate as above; write 3 on the left of the line and remove the decimal point three places to the left.

Find the interest on \$348 for 24 days at $1\frac{1}{4}$ per cent. per month.

$$\left.\begin{array}{r|l} 3 & 348 \\ & 24 \\ 4 & 5 \end{array}\right\} = 3.480 \quad = \quad \$3.48.$$

Legal Interest is reckoned on the basis of 365 days to the year, when this is required, and the calculation is made on the basis of 360 days, subtract $\frac{1}{73}$ for the common year, or $\frac{1}{61}$ for a leap year, and the legal interest will be shewn; about $1\frac{1}{3}$ cents for each dollar of interest.

RAPID

RULES FOR FARMERS.

The practice of buying or selling grain by the 100 pounds, or the *cental* system, is becoming almost universal, and has many advantages over the bushel.

The following rules for finding the relative values of the bushel and the cental are easy to learn, and true and rapid in execution.

To find the value per cental when the price per bushel is given.

Rule.—Set down the price per bushel; remove the decimal point two places to the right, and divide by the number of pounds in the bushel.

Example.—If wheat is $1.80 per bushel, what is its value per cental? Ans. $3.

Process— 60) 180

3

To find the value per bushel when the price per cental is given.

Rule.—Set down the price per cental; multiply by the number of pounds in the bushel, and remove the decimal point two places to the left.

EXAMPLE.—If wheat is $3.00 per cental, what is the value of a bushel? Ans. 1.80.

Process—

$$\begin{array}{r} 3.000 \\ 6 \\ \hline 1.8000 \end{array}$$

RAPID RULE FOR RECKONING THE COST OF HAY.

RULE—Multiply the number of pounds by half the price per ton, and remove the decimal point three places to the left.

EXAMPLE.—What is the cost of 764 lbs. of hay at $14 per ton? Ans. $5.348.

Process—

$$\begin{array}{r} 764 \\ = \quad 7 \\ \hline 5.348 \end{array}$$

NOTE.—The above rule applies to anything of which 2,000 pounds is a ton.

To Measure Grain.

RULE.—Level the grain; ascertain the space it occupies in cubic feet; multiply the number of cubic feet by 8, and point off one place to the left.

EXAMPLE.—A box level full of grain is 20 feet long, 10 feet wide, and 5 feet deep. How many bushels does the box contain? Ans. 800 bush.

Process—$20 \times 10 \times 5 \times 8 \div 10 = 800$.

Or,

$$\begin{array}{r} 1\,0\,0\,0 \text{ ft.} \\ 8 \\ \hline 8\,0\,0.0 \end{array}$$

NOTE.—Exactness requires the addition to every one hundred bushels of .44 of a bushel.

The foregoing rule may be used for finding the number of gallons, by multiplying the number of bushels by 8.

If the corn in the box is in the ear, divide the answer by 2, to find the number of bushels of shelled corn, because it requires two bushels of ear corn to make one of shelled corn.

RAPID RULES FOR MEASURING LAND WITHOUT INSTRUMENTS.

In measuring land, the first thing to ascertain is the contents of any given plot in square yards; then, given, the number of yards, find out the number of rods and acres.

The most ancient and simple measure of distance is a step. Now, an ordinary-sized man can train himself to cover 1 yard at a stride, on the average, with sufficient accuracy for ordinary purposes.

To make use of this means of measuring distances, it is essential to walk in a straight line; to do this, fix the eye on two objects in a line straight ahead, one comparatively near, the other remote;

and, in walking, keep these objects constantly in line.

Farmers and others by adopting the following simple and ingenious contrivance, may always carry with them the scale to construct a correct yard measure.

Take a foot rule, and commencing at the base of the little finger of the left hand, mark the quarters of the foot on the outer borders of the left arm, pricking in the marks with indelible ink.

To find the area of a four-sided figure, two of which sides are parallel.

RULE.—Multiply the length and the breadth together, and the product is the area.

To find the area of a square, square one of its sides.

RULE.—When the length of two opposite sides is unequal, add them together, and take half the sum and multiply by the breadth.

EXAMPLE 1. How many square yards in a square piece of land, 101 yds. on each side?

Process—$101^2 =$ Ans. 10,201 yards.

EXAMPLE 2. How many yards in a piece of land 60 yards long and 20 yards wide? Ans. 1200.

Process—$600 \times 2 = 1200$.

EXAMPLE 3. How may yards in a piece of land, one side is 40 yards long, and the other side 60 yards long, parallel sides being 10 yards apart?

Process, $$\frac{40 + 60 \times 10}{2} = 500.$$

500 yards, Ans.

To find the area of any three-sided figure.

RULE.—Multiply the longest side into one-half the distance from this side to the opposite angle.

EXAMPLE.—What is the area of a triangular plot of land, the longest side of which is 80 yards, and the shortest distance from this side to the opposite angle 40 yards?

Process, $$\frac{40 \times 80}{2} = 1600 \text{ yds. Ans.}$$

To find how many rods in length will make an acre, the width being given.

RULE.—Divide 160 by the width, and the quotient will be the answer.

EXAMPLE.—If a piece of land be 4 rods wide, how many rods in length will make an acre?

$160 \div 4 = 40$ rods Ans.

To find the number of acres in any plot of land, the number of rods being given.

RULE.—Divide the number of rods by 8, and the quotient by 2, and remove the decimal point one place to the left.

EXAMPLE.—In 6840 rods, how many acres?

42¾ acres Ans.

Process.— 8)6840

2)855

42.75

To find the number of acres, the number of yards being given.

Divide the number of yards by 4840 or its factors.

EXAMPLE.—Find how many acres in 21,780 yds.

$$\frac{21,780}{10\times11\times11\times4}=4.5 \qquad \text{Ans. } 4\tfrac{1}{2} \text{ acres.}$$

A circle encloses the largest area within the shortest fence.

The length of a circular fence = the square root of the area $\times\ 1\frac{1}{8}\times3\frac{1}{7}$.

Find the length in yards of a circular fence to enclose 10 acres.

$$\sqrt{48400}=220. \quad 220\times1\tfrac{1}{8}\times3\tfrac{1}{7}=780 \text{ yards.}$$

A square plot of the same area requires a fence 880 yards long.

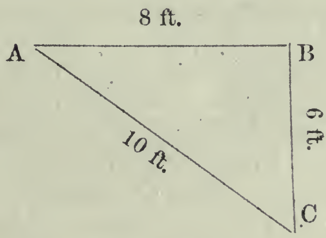
The largest area enclosed within the shortest fence, in a rectangular plot, is a square.

393½ yards of fence will enclose a square plot of two acres; it would require 2 miles and 2 rods of fence to enclose the same area in a rectangular plot 1 rod wide.

RAPID

RULES FOR MECHANICS.

To lay off a square corner.—Measure off eight feet from the end of one sill, and there make a mark; then measure off six feet on the sill lying at right angles with the first, and make another mark; then lay on a ten foot pole, one end of it squarely with the first mark. Move the sill in or out until it exactly squares with it. The figure thus made in marking off the sills, and in the laying down the ten foot pole is a right angle triangle.



Another method for laying off a square corner.

Take a measure and lay off with it a triangle, one side of which is four feet long, another three feet, and the remaining side five feet. This triangle will be right angled, and the two shorter sides will serve to lay off an exact square.

To Measure Grindstones, or any Cylinder.

RULE.—Multiply the square of the radius by the thickness, both in feet, or fractions of a foot, and the product by $3\frac{1}{7}$;

or

Multiply the square of the diameter by the thickness, both in inches, and divide by 2200, the answer is in cubic feet.

EXAMPLE.—How many feet in a grindstone 24 inches in diameter and 4 inches thick?

1st Method.

$$\frac{1 \times 1 \times 22}{3 \times 7} = 1{\cdot}04$$

2nd Method.

$$\frac{24 \times 24 \times 4}{2 \times 11} = 1{\cdot}04 \text{ ft.}$$

Measure of Superfices and Solids.

Superficial measure is that which relates to length and breadth only, not regarding thickness. It is made up of squares, either greater or less, according to the different measures by which the dimensions of the figure are taken or measured. Land is measured in this way, its dimensions being taken in inches, feet and yards, or links, rods and acres. The contents of boards also, are found in this way, their dimensions being taken in feet and inches. The standard of measure is as follows: 12 inches in length make one foot of long measure; therefore, $12 \times 12 = 144$, the square inches in a superficial foot.

1. If the floor of a room be 20 feet long by 18 feet wide, how many square feet are contained in it? Ans. 360 feet.

Process—$180 \times 2 = 360$.

2. If a board be 4 inches wide, how much in length will make a foot square? Ans. 36 inches.

Process—144 divided by the width, thus, $\frac{144}{4} = 36$.

3. If a board be 21 feet long and 18 inches broad, how many square feet are contained in it? Ans. $31\frac{1}{2}$ sq. ft.

Process—Multiply the length in feet by the breadth in inches, and divide the product by 12.

$$\frac{21 \times \overset{3}{\cancel{18}}}{\underset{2}{\cancel{12}}} = 31\tfrac{1}{2}.$$

Or thus, 18 inches equals $1\frac{1}{2}$ ft.; $21 \times 1\frac{1}{2} = 31\frac{1}{2}$.

To measure a board wider at one end than the other, of a true taper.

RULE.—Add the widths of both ends together; halve the sum for the mean width, and multiply the mean width by the length.

EXAMPLE.—How many square feet in a board 20 feet long, 9 inches in width at one end, and 11 inches at the other? Ans. $16\frac{2}{3}$ sq. ft.

Process—

$$\frac{9 + 11}{2} = 10 \text{ in., mean width; } \frac{20 \times 10}{12} = 16\tfrac{2}{3}.$$

To find the board measure of planks and joists.

RULE.—Find the contents of one side of the plank or joist by the preceding rule, and multiply the result by the thickness in inches.

EXAMPLE.—What is the board measure of a plank 18 feet long, 10 inches wide, and 4 inches thick? Ans. 60 ft.

Process— $$\frac{18 \times 10 \times 4}{12} = 60.$$

The diameter being given, to find the circumference.

RULE.—Multiply the diameter by $3\frac{1}{7}$.

EXAMPLE.—What is the circumference of a wheel the diameter of which is 42 inches? Ans. 11 ft.

$$\frac{42 \times 3\frac{1}{7}}{12} \text{ or } \frac{7 \times 22}{2 \times 7} = 11 \text{ feet.}$$

To find the diameter when the circumference is given.

RULE.—Divide the circumference by $3\frac{1}{7}$.

EXAMPLE.—What is the diameter of a wheel, the circumference of which is 11 feet? Ans. $3\frac{1}{2}$ feet

Process— $$\frac{\cancel{11}}{1} \times \frac{7}{\underset{2}{\cancel{22}}} = 3\tfrac{1}{2}$$

What is the width of a circular pond, 154 rods in circumference? 49 rods Ans.

Process— $$\frac{\overset{7}{\cancel{154}}}{1} \times \frac{7}{\cancel{22}} = 49.$$

The diameter being given, to find the area.

RULE.—Multiply the square of the radius by $3\frac{1}{7}$.

Find the area of a circle 36 inches in diameter.

$$\frac{3 \times 3 \times 22}{2 \times 2 \times 7} = 7.07 \text{ feet.}$$

The length of a cylinder is equal to the capacity $\div$ the square of the radius $\div 3\frac{1}{7}$.

Find the depth of a circular cistern, 7 feet wide, containing 2400 U. S. gallons.

$$\frac{2400 \times 2 \times 2 \times 2 \times 7}{15 \times 7 \times 7 \times 22} = 8.31 \text{ feet.}$$

To find how many solid feet a round stick of timber of the same thickness throughout, will contain when squared.

RULE.—Square half the diameter, in feet, multiply by the depth, and then by 2.

Find how many solid feet, when squared, in a round log $2\frac{1}{2}$ feet wide and 10 feet long.

$$\frac{5\times5\times10\times2}{4\times4}=31.25 \text{ feet.}$$

General rule for measuring timber to find the solid contents in feet.

RULE.—Multiply the depth, in feet, or fractions of a foot, by the breadth, multiplied by the length.

How many solid feet in a piece of timber 2 feet wide, 10 inches thick and 12 feet long.

$$\frac{2\times5\times12}{6}=20 \text{ feet.}$$

To find the contents of a true tapered pyramid, whether round, square, or triangular.

RULE.—Multiply the area of the base by $\frac{1}{3}$ the height.

How many cubic feet in a round stick of timber, truly tapering to a point, $1\frac{1}{2}$ feet in diameter at the base and 24 feet long.

$$\frac{3\times3\times22\times8}{4\times4\times7}=14.14+ \text{ feet.}$$

How many cubic feet in a square block of

marble, truly tapering to a point, 24 inches on each side at the base, and twelve feet high.

$$\frac{24\times24\times4}{144} \text{ or } 2\times2\times4=16 \text{ feet, Ans.}$$

Gaugers' Work.

To find the contents of a cask in gallons.

Rule.—Add two-thirds the difference of the head and bung diameters to the head diameter, to find the mean diameter; then multiply the product of the square of the mean diameter into the length by .0034.

Note.—If the staves are but little curved, add six-tenths instead of two-thirds.

How many gallons in a cask, length 40 in., head diameter 21 in. and bung diameter 30 in.?

$\therefore 21+(\overline{30-21}\times\frac{2}{3})=27$ in. mean diameter.

$\therefore 27^2\times40\times.0034=99.144$ gallons.

Bricklayers' Work

Is sometimes measured by the perch, but more frequently by the 1000 bricks laid in the wall.

The following scale will give a fair average for estimating the quantity of brick required to build a given amount of wall:

$4\frac{1}{2}$ in. wall,	per ft.,	superficial,		($\frac{1}{2}$ brick)	7	bricks.
9	"	"	"	(1 brick)	14	"
13	"	"	"	($1\frac{1}{2}$ brick)	21	"
18	"	"	"	(2 bricks)	28	"
22	"	"	"	($2\frac{1}{2}$ bricks)	35	"

NOTE.—For each half brick added to the thickness of the wall, add seven bricks.

A bricklayer's hod measuring 1 ft. 4 in. × 9 in. × 9 in., equals 1,296 inches in capacity, and will contain 20 bricks.

A load of mortar measures 1 cubic yard, or 27 cubic feet; requires 1 cubic yard of sand, and 9 bushels of lime, and will fill 30 hods.

Plasterers' Work

Is measured by the square yard, for all plain work· by the foot, superficial, for plain cornices; and by foot, lineal, for enriched or carved mouldings in cornices.

Painters' Work

Is computed by the superficial yard; every part is measured that is painted, and an allowance is added for difficult cornices, deep mouldings, carved surfaces, iron railings, etc. Charges are usually made for each coat of paint put on, at a certain price per yard per coat.

Howard's New Rule
FOR COMPUTING INTEREST
On a basis of One Per Cent for all Rates.

Interest, in the various forms under which it accrues, has so large a place in every day business transactions, that a rapid and accurate method of computing *interest* is one of the most indispensable items of business knowledge.

The one that I present here, in all respects, is, without exception, the *newest*, the *easiest to learn*, and *use*, the *quickest* and *most correct* in existence, adapted to *all sums*, *all periods*, and *all rates per cent.*

Some of the reasons that suggested the construction of this rule will assist the learner in its acquirement. A child first conceives the idea of ONE thing, by and by, it is able to count SIX, but it is a long time before it apprehends that the six counted is six ONES.

THE UNIT—or one thing—is the idea of number in its simplest form, it is the basis of every number, the primary base of every fraction, the *unit* of *six* months is *one* month, the unit of a fraction is the reciprocal of the denominator, thus, $\frac{1}{8}$ is the *unit* of $\frac{5}{8}$; every step from the unit, increases the complexity of numbers, and consequently demands an increase of mental power and energy in dealing with them.

The most popular Interest rule is the "*six per cent*" method, by this rule, on removing the decimal point two places to the left, the interest on any sum is shewn for *one-sixth* of a year at *six* per cent. The interest on any sum is shown for *one* year at *one* per cent by the same act; the latter, which retains the *unit* of both denominations,—unchanged—must be the most natural and simple basis of calculation, and by consequence, the easiest to learn and use, hence the following :—

Rule,—Multiply .01 *of the principal by the given time and the product is the interest at one per cent.—Multiply the interest at one per cent by the given rate.*

NOTE 1,—Multiply by easy fractions of a year, or month, and the result will be uniformly correct, and requires less than half the mental labor demanded by other methods, a little practice, and careful study of the details of the following examples will enable the learner to select *instantaneously* the *easiest* multipliers,

NOTE 2.—To multiply by .1 remove the decimal point *one* place to the *left*; by .01 *two* places; by .001 *three* places.

What is the interest on £1000 for 11 yrs., 1mo and 6 days at 1 per cent per annum?

		Yr.	Mo.	Da.	
£10.00	Int. for	1	"	"	
100.00	" "	10	"	"	first line $\times$ 10
1.00	" "		1	6	" " $\times$ .1
£111.00	" "	11	1	6	

What is the interest on $846 for 1 yr. 7 mo., 12 da. at 1 per cent?

		Yr.	Mo.	Da.	
$8.46	Int. for	1	"	"	
4.23	" " "		6	"	1st line $\times \frac{1}{2}$ because 6 mo. is $\frac{1}{2}$ a year.
.705	" " "		1	"	2d " $\times \frac{1}{6}$ " 1 " " $\frac{1}{6}$ of 6 mo.
.282	" " "		"	12	3d " $\times$ .4 " 12 da " .4 of 1 mo.
13.677	" "	1	7	12.	

What is the int. on $427.20 for 2 yr., 5 mo., 27 da at 6 per cent?

		Yr.	Mo.	Da.		
$4.272	int. for	1	"	"	at 1 per cent.	
4.272	" "	1	"	"	" " " "	
1.424	" "	"	4	"	" " " "	1st line $\times \frac{1}{3}$
.356	" "	"	1	"	" " " "	3d " $\times \frac{1}{4}$
.3204	" "	"	"	27	" " " "	4th " $\times$ .9
10.6444	" "	2,	5,	27	" 1 " "	
63.8664	" "	"	"	"	" 6 " "	R 37

What is the int. on £124.50 for 1 yr. 4 mo. 12 da. at 5 per cent per annum?

		Yr.	Mo.	Da.	
£1.245	int. for	1 yr.	mo.	da.	
.415		"	4	"	1st. line $\times \frac{1}{3}$
.0415		"	"	12	2d " $\times$ .1
1.7015		1	4	12	

£8.5075 Int. at 5 per cent. *E*192

NOTE. The interest is found on all sums at 1 per cent. a month by removing the decimal point to the left, 3 places for 3 days, and 2 places for 30 days.

Find the interest on £143 for 1 mo. 3 da. at 1 per cent per month.

£1.43 int. for 1 mo.
.143 " " 3 days 1st. line × .1
£1.573 Ans.

Find the int. on $216 for 7 mo. 18 da. at 2 per cent per month.

$2.16 int. for 1 mo. at 1 per cent.
15.12 " " 7 " " " " " 1st line × 7
1.296 " " 18 da. " " " " " " × .6
16.416
$32.832 Int. for 7 mo. 18 da. at 2 per cent. Ans.

Find the Int. on $846.50 for 5 mo. 19 da. at $1\frac{1}{4}$ per cent per month.

$8.465
42.325 1st line × 5
2.822 " " × $\frac{1}{3}$ because 10 days is $\frac{1}{3}$ of a mo.
2.5395 " " × .3 " 9 " " .3 " "
47.6865
11.9216 previous line × $\frac{1}{4}$
$59.6081 int. for 5 mo. 19 da. at $1\frac{1}{4}$ per cent Ans.

Find the Int. on £715 for 8 mo. 11 da. at .9 of 1 per cent month.

£7.15 Int. for 1 mo.
57.20 " " 8 "
1,43 " " 6 da. $=\frac{1}{5}$ of 1 month.
1.192 " " 5 " $=\frac{1}{6}$ " " "
59.822
£53.8398 int. for 8 mo. 11 da. at .9 of 1 per cent.

Legal Interest

is computed on the basis of 365 days to the year.

The LEGAL INTEREST on £1, or $1, for 1 day, at 1 per cent per annum, is .0000274, hence the following

Rule.—Annex 0 *to the number of days, multiply by* 274 *reversed, then annex* 0 *to the number of pounds, or dollars, multiply by the figures in the first product, reversed, remove the point four places to the left, and the interest for the given time, and principal, is shewn at* 1 *per cent per annum. Multiply this by the given rate.*

Find the LEGAL interest on £233 Stg. for 232 days at 7 per cent per annum.

£2330	2320
6536	472
13980	4640
699	1624
116	92
14	6356
1.4809 int. at 1 per cent.	
7	£ s. d.
10.3663 int. at 7 per cent.	Ans. 10 : 7 : 4

Find the interest on £719,, 17,, 9, for 2 yrs. 7 days, at 1 per cent

£719.837	070
291 02	472
1439 77	140
7 20	49
6 47	3
14	20192
14.5358	

Note.—When the time is in years and days, to the product of the days by 472, prefix for 1 yr. 10, for 2 yrs. 20 &c., and use two decimals in the princpal.

Ans. £14,,10,,8½.

Howard's New Rule

For Computing Interest by dividing the year, or month, by the rate, may be used in all cases when the figure. or figures, representing the rate, is the aliquot part of a year, or month, under this rule the interest can be found in the twinkling of an eye, on a million examples, for three periods of time, without altering one figure of the principal.

Rule.—Divide the year, or month, by the rate, and the Quotient is the time in which £1 *stg., or* $1, *earns* .01 *part of itself, to find the interest for the quotient, remove the decimal point two places, for* .1 *that time, three places, and for ten times the quotient, one place to the left.*

Find the interest on $714.50 for 400 days at 9 per cent per annum. Ans. $71.45.

Explanation, 360 ÷ 9 = 40, in 40 days the dollar earns a cent, the interest is found for 40 days at 9 per cent, by removing the point *two* places to the left, for 10 times 40 days, by removing the point *one* place.

Find the interest on $125 for 10 days at 3 per cent per month. Ans. $1.25.

Explanation 30 days ÷ 3 = 10 days, in ten days, one dollar earns *one* cent, at 3 per cent per month.

Or, multiply the principal by the given number of days and divide by the qoutient of 360 *divided by the given rate, and remove the point two places to the left.*

Find the interest on £714,,8 for 23 days @ 9 % per an.

$$\frac{714.4 \times 23}{4} = 4107.8 \qquad \text{Ans. £4.1078.}$$

NOTE 1.—When the figure in the units' place of the quotient is 0, divide by the tens only, and remove the point three places to the left.

NOTE 2.—Divide the number of days in the year by any given rate, and the quotient is the number of dollars that will earn one cent in one day at the given rate.

HOWARD'S BANK OF ENGLAND RULE

is the handiest for computing Legal Interest.

$\overline{1 \times 1\frac{3}{20}} \div 1000 = \overline{1 \times 42} \div \overline{365 \times 100}$ nearly.

The difference is about $\frac{1}{1680}$; six cents to be added to each \$100; exactly one penny to each £7 of interest; hence the following:

To compute interest for any number of days, 365 days to the year:

RULE.—Multiply the principal by $1\frac{3}{20}$, remove the point *three* places to the left, and the interest will be shown for the following number of days, and rates, to find the interest for any other time or rate, increase or diminish:—

42	days at	1	per cent.	7	days at	6	per cent.
21	"	2	"	6	"	7	"
14	"	3	"	4	"	$10\frac{1}{2}$	"
12	"	$3\frac{1}{2}$	"	3	"	14	"
$10\frac{1}{2}$	"	4	"	2	"	21	"

Remove the point *two* places to the left, and the interest will be shown for

84	days at	5	per cent.	35	days at	12	per cent.
56	"	$7\frac{1}{2}$	"	28	"	15	"
42	"	10	"				

Example: What is the interest on £100 for fourteen days at 3 per cent. per annum?

$$\begin{array}{r} 100 \\ 10 \\ 5 \\ \hline .115 \end{array}$$

Ans. 2*s*. $3\frac{3}{4}$*d*.

NOTE.—To multiply by $1\frac{3}{20}$, add $\frac{1}{10}$ and $\frac{1}{2}$ of $\frac{1}{10}$ of any number to itself.

Compound interest is interest on the principal, and also on the interest added to the principal, each time it becomes due.

RULE.—Multiply the principal by the rate, setting the product under, and two decimal places to the right of the principal; the sum of principal and interest will be the amount.

Or, find the amount of £1, or $1, for the given time and rate, and multiply by the given principal.

NOTE.—To avoid writing decimals of no value, begin at the third decimal, adding in the figure carried, if any, from the right hand figures.

Find the amount of £864 10s. 0d. for six years at 8%. Ans. £1371 17s. $0\frac{3}{4}$d.

School Book Method, 184 Figures.

```
        864.5
            8
        69160
       8645
      933.660
            8
       746928
      93366
     1008.3528
             8
      80668224
    10083528
     1089.021024
               8
      8712168192
   1089021024
     1176.14270592
                 8
      940914164736
  117614270592
     1270.2341223936
                   8
    101618729791488
   1270.2341223936
  £1371.85285.2185088
```

Howard's Method, 74 Figures.

```
   864.5
    69.16
   933.66
    74.693
  1008.353
    80.668
  1089.021
    87.122
  1176.143
    94.091
  1270.234
   101.619
 £1371.853
```

To repay a loan, principal and compound interest in a given number of equal annual payments.

RULE.—Multiply the *amount* of one pound, or one dollar for the given time and rate, by the *interest* for one year, and divide the product by the *compound interest* on a pound, or dollar, for the given time and rate

EXAMPLE.—What must the be one of six equal annual payments to discharge a loan of £864,, 10,, for six years at 8 per cent.

$$\frac{1.5869\times 69.16}{.5869}=£187,,0,,0.$$

NOTE 1.—Persons having frequent occasion to compute compound interest may save time and labor by the use of a table showing the amount of one pound, or one dollar, for a series of years, or other stated periods; the amount of one pound, or one dollar, for the given time and rate, multiplied by the given number of pounds, or dollars, will be the amount sought.

NOTE 2.—To prove interest, divide the computed interest by the interest for one day, and the quotient should be the number of days in the example; or divide by the interest for one month, and the quotient should be the number of months.

DISCOUNT.

Discount, being of the same nature as interest, is, strictly speaking, the use of money before it is due. The term is also applied to a deduction of so much per cent. from the face of a bill, or the deducting of interest from the face of a note before any interest has accrued. Banks generally include

in their reckoning both the day when the note is discounted and the day on which the time specified in it expires, which, with three days of grace, makes the time for which discount is taken four days more than the time specified in the note. *True Discount* differs from *Bank Discount*, that is, the true discount on a debt of 109 dollars due a year hence would be 9 dollars, the legal interest being at the rate of 9 per cent., and the present worth of the note is 100 dollars.

In calculating interest the sum on which interest is to be paid is known, but in computing discount we have to find what sum must be placed at interest, so that the sum, together with its interest, will amount to the given principal; the sum thus found is called the "Present worth."

To find the present worth of any sum, and the discount for any time at any rate per cent.

Rule.—Divide the given sum by the amount of $1 for the given time and rate, and the quotient will be the present worth, and the remainder will be the discount.

Example 1.—Find the present worth of a note for 228 dollars, due 2 years from date at 7 per cent.
Ans. $200.

2. Find the bank discount on a note for £1200, for 60 days at 6 per cent.

$60 + 4 = 64$ days time for which discount must be reckoned. $\frac{1}{6}$ of $64 = 10\frac{2}{3} \times 1200 = 12\,800$.

Ans. 12.80.

Merchants are in the habit of deducting a certain percentage from invoices of goods sold. This is reckoned in the same manner as interest.

A bill of goods is bought, amounting to 960 dollars at a year's credit, the merchant offers to deduct 10% for ready cash, what amount is to be deducted?

$9.60 \times 10 = \$96.00$, Ans.

By discounting the face of bills, a loss may be sustained without suspecting it; this arises from the fact that the discount is not only made on the first cost of the goods, but also on the profits; for instance, if a profit of 30% be made on any article of merchandise, and the 10% be deducted, the gain at first sight would appear to be 20%, but is in reality only 17%. If a profit of 60% be added to the first cost, and then a discount made of 45%, the apparent profit would be 15%; instead of this, an actual loss is made of 12%, as will be seen by the following examples:

Example 1.

Cost of goods,	\$100
Add 30% profit,	30
Selling price,	130
Deduct 10% discount,	13
Cash price,	\$117
Gain 17%.	

Example 2.

Cost,	\$100
Profit 60%,	60
Selling price,	160
Discount 45%,	72
Cash price,	\$88
Loss 12%.	

The net amt. of a bill, less 10 per cent discount, will be shewn by multiplying by 9, and removing the decimal point one place to the left. Example. £100×9=£90.0

To find the net. amt. less discount at

5 per cent ×9½.	30 per cent ×7.	50 per cent ×5.
15 " " ×8½.	35 " " ×6½.	55 " " ×4½.
20 " " ×8.	40 " " ×6.	60 " " ×4.
25 " " ×7½	45 " " ×5½.	70 " " ×3.

and remove the point 1 place to the left.

EXCHANGE.

EXCHANGE is the giving or receiving of any sum in one kind of money for its value in another.

EXAMPLE 1. Find the value of gold, the price of greenbacks being 75 cents Ans. 133⅓.

Process— $\frac{100}{75} = \frac{4}{3} = 1.33\frac{1}{3}$

2. Find the value of currency, the price of gold being 133⅓. Ans. 75 cents.

Process— $\frac{100}{133\frac{1}{3}} = \frac{3}{4} = .75$

$500 in gold at 8 per cent. premium will buy how much currency?

$\$500 \times 1.08 = \$540$

$500 in currency will buy how much gold at 8 per cent premium?

$500 \div 108 = \$462.96.$

$1000 in gold is worth how much currency at 80 cents?

$\$1000 \div .80 = 1250.$

What is the face value of a bill of Exchange costing £1000. Commission $\frac{3}{4}$ per cent?

£1000÷1.0075=£992.55

What is the cost of a bill of Exchange for $1000 Premium $\frac{3}{4}$ per cent.

$1000×1.00$\frac{3}{4}$=$1007.50.

Find the par value of £473 ,, 5 ,, 9 St'g. in American gold coin.

£473.2875×4.8665=$2303.25.

473.2875
56.684
1893.150
378.630
28.397
2.839
.237
2303.254

Note. To avoid encumbering the operation with valueless decimals, reverse the multiplier, and begin each line of the partial products with the product of the multiplying figure and the figure directly above it, adding what otherwise would have been carried.

The par value of £1 st'g is fixed by act of Congress 1873, at $4.8665.

BRITISH MONEY.

Howard's new rules for INTEREST, EQUATION OF PAYMENTS, &c., may be used with equal facility in dealing with British and other foreign money.

The British people would simplify all their monetary operations, and save millions every year in labor alone, by adopting the decimal system of coinage. The cost and temporary inconvenience incident to the change would be trifling, almost *nil*, in view of the advantage to be gained. The pound, the florin, the shilling and the sixpence might be retained. Make the smallest coin, the farthing, equal to the $\frac{1}{1000}$ of a pound, and the thing is done.

NOTE.—By carefully observing and practicing the following instructions, the converting of shillings, pence and farthings into decimals of a pound, and *vice versa*, will become a purely mental and instantaneous operation.

1. For every two shillings, or florin, write .1, because two shillings is $\frac{1}{10}$ of a pound stg.

2. For every 1 shilling, write .05, because one shilling is $\frac{5}{10}$ of a florin, or $\frac{5}{100}$ of a pound stg.

3. For every ninepence, write .0375, because ninepence is $\frac{375}{10000}$ of a pound stg.

4. For every sixpence, write .025, because sixpence is $\frac{25}{100}$ of a florin or $\frac{25}{1000}$ of a pound stg.

5. For every threepence, write .0125, because threepence is $\frac{125}{10000}$ of a pound stg.

6. For the farthings, write the product of .00104 multiplied by the number of farthings.

£		s.		d.		far.
1	=	20	=	240	=	960
.1	=	2	=	24	=	96
.05	=	1	=	12	=	48
.0375	=	$\frac{3}{4}$	=	9	=	36
.025	=	$\frac{1}{2}$	=	6	=	24
.0125	=	$\frac{1}{4}$	=	3	=	12
.00104	=	$\frac{1}{48}$	=	$\frac{1}{4}$	=	1

£ 19,,2	= 19.1	£ 27,,12,,6	=27.625
19,,3	= 19.15	19,,19,,2$\frac{1}{2}$	=19.96
19,,5	= 19.25	19,,18,,0$\frac{3}{4}$	=19.903
19,,19	= 19.95	19,,16,,1$\frac{3}{4}$	=19.807
19,,18	= 19.9	24,, 1,,1$\frac{1}{2}$	=24.056

The learner may extend the exercises indefinitely, the *essentials* to remember are—

1st. Each unit of the first figure to the right of the decimal stands for *two* shillings.

2d. Each 5 in the second figure to the right of the decimal, stands for *one* shilling.

3d. Each unit *above* or *below* 5 in the second figure, stands for $2\frac{1}{2}$ pence.

4th. Each unit of the third figure to the right of the decimal, stands for 1 farthing.

NOTE.—The *exact* value of each unit in the second figure to the right of the decimal is $2\frac{4}{10}$ of a penny, and of each unit in the third figure to the right of the decimal, $\frac{24}{100}$ of a penny, the difference of the assumed and the real value is too trifling to affect any actual business operation. The *florins*, *shillings*, *ninepence*, *sixpence* and *threepence* are decimally expressed *absolutely* correct.

PERCENTAGE.

The following examples embrace most of the conditions under which *percentage* occurs in business, and the mode of solution in each case applies to all similar examples.

How many of 500 sheep will be left, if 20 per cent. of them are sold?

$500 \times .20 = 100.$ $500 - 100 = 400$ *sheep.*

What per cent of 300 is 75? $75 \div 300 = 25$ ℔ ct.

Of what number is 48, 8 ℔ ct.? $48 \div .08 = 600.$

Sold a horse for £60, made 25 ℔ ct., what did it cost? $1 + .25 = \frac{125}{100} = \frac{5}{4}$ $5 \mid \frac{4}{60} =$ £48

Sold a horse for \$40, lost 20 ℘ ct. What did it cost?

$1-.20=\frac{80}{100}=\frac{8}{10}$ $\quad 8 \mid \frac{10}{40}=50$ *dollars.*

The population of a village increased from 900 to 1200, at what rate per cent. did it increase ?

$1200 \div 900 = 1.33\frac{1}{3} - 1 = 33\frac{1}{3}$ *per cent.*

The sales of a firm fell off from £12000 to £9000, what was the rate per cent of decline ?

$9000 \div 12000 = .75.$ $1-.75=25$ *per cent.*

Bought a horse for \$80, sold it for \$105. What per cent profit?

$105 \div 80 = 1.31\frac{1}{4} - 1 = 31\frac{1}{4}$ *per cent.*

Bought a piano for \$300, sold it for \$250. What per cent. loss?

$300-250 \div 300 = .16\frac{2}{3}$ *per cent.*

Bought a horse for \$40. What must it be sold for to gain 20 per cent?

$40 \times .20 = 8 + 40 = 48$ *dollars.*

A horse was sold for \$24; the rate per cent profit was the same as the number of dollars it cost. What was the cost, and what the gain per cent?

Cost \$20. $20^2=400 \times .01=4.$ *Profit* \$4, *or*

$\sqrt{}$ *of the profit is* .1 *the cost.* $\sqrt{}$ *of* $4=2 \times 10=20$ *Cost* \$20. *Profit* 20 *per cent.*

How many dollars will earn 1 cent a day at 9 per cent per annum?

$360 \div 9 = 40.$ *Ans.*\$40.

How many dollars will earn 1 cent a day at $1\frac{1}{4}$ per cent per month?

$30 \div 1\frac{1}{4} = 24.$ *Ans.*\$24.

STOCKS AND BONDS.

Stocks and bonds are quoted in New York by so much on the hundred, premium or discount; in Philadelphia at their actual price. That is, if the par value of a stock is $50, and it is 6% above par, the New York quotation would be 106, the Philadelphia quotation 53.

When the premium is known, the par value plus the premium equals the market value. When at a discount, the par value minus the discount equals the market value.

To find to what rate of interest a given dividend corresponds.

RULE.—Divide the rate per unit of dividend by 1 plus or minus the rate per cent., premium or discount, according as the stocks are above or below par.

What per cent will be gained by investing in 8 per cent stock, at 20 per cent premium?

120 | 800=$6\frac{2}{3}$ *per cent.*

What per cent will be gained by investing in 6 per cent stock at 10 per cent discount.

100−10=90. 90 | 600=$6\frac{2}{3}$ *per cent.*

To find at what price stock paying a given rate per cent. dividend can be purchased, so that the money invested shall produce a given rate of interest.

RULE.—Divide the rate per unit of dividend by the rate per unit of interest.

What must be paid for stock paying 6 per cent dividend, in order to realize on the investment 8 per cent?

8 | 600=75.

HOWARD'S
GOLDEN RULE.
FOR
EQUATION OF PAYMENTS,

AVERAGING ACCOUNTS and PARTIAL PAYMENTS, is so called, not only because it is absolutely correct, and consequently equally just to both Debtor and Creditor, but also because it is exceedingly simple, and easy to learn and use.

The methods hitherto in use are *intricate*, *tedious*, and *perplexing*, and more or less *inaccurate:* the PRODUCT methods requiring, with each item, the finding the number of days between two dates, and the use of difficult multipliers.

The INTEREST methods introduce a *superfluous* element, and needlessly increase the complexity of the operation. Interest, really has nothing to do with finding when a balance is due.

The object sought is a *certain date,* HOWARD'S GOLDEN RULE seeks and finds this—*and this only*—directly, accurately and easily. By its use the CASH BALANCE of the most complex Dr. and Cr. accounts may be easily found, without reference to interest, except where it properly belongs; viz,—on the balance.

The novel and special excellence of this rule consists in multiplying by months, and easy fractions of a month, and also in the *simple* and *natural* arrangement of the parts of the problem, the dates themselves representing the multipliers.

Experienced Accountants say, "it very much lessens the *drudgery* of the counting house."

EQUATION OF PAYMENTS is the process of finding the EQUATED TIME, or the date when the sum of several debts due at different times may be paid and includes,—

Bills bought on *unequal* time on the *same* date.
Bills bought on *equal* time on *different* dates.
Bills bought on *unequal* time on *different* dates, and MONTHLY STATEMENTS.

AVERAGING ACCOUNTS is the process of finding the date on which the BALANCE is due, and applies to all Dr. and Cr. accounts.

PARTIAL PAYMENTS are parts of a debt paid at different times; usually written on the back of notes and other interest bearing obligations, and called indorsements. The term also includes payments made on account of a debt before it is due.

TERM OF CREDIT is the time to elapse before a bill becomes due.

The AVERAGE TERM of credit is the time at the end of which the sum of several debts due at different dates may be paid at once.

EQUATED TERM is the average time for which interest is due on an account, or balance, and is always reckoned from the zero date.

Interest is reckoned on accounts, and balances from the date on which they are due.

AN ACCOUNT is a statement of business transactions between Debtor and Creditor.

A BALANCE is the difference of two sides of an account.

A CASH BALANCE is the same, with the interest due.

THE ZERO DATE is the date,—or starting point,—from which all the other dates are reckoned, in this rule it is always the beginning—or starting point—of the month in which the first debt in the acct. occurs.

BILLS BOUGHT ON UNEQUAL TIME ON THE SAME DATE.

1878, Jan. 1st,	Bought goods on 8 mos.	£100
" " "	" " " 6 "	100
" " "	" " " 7 "	100

On what date may the whole £300 be paid?

Term of Cr M o..	Date.	
8	Jan. 1.	100×8=800
6	" "	100×6=600
7	" "	100×7=700
		300)2100(7 mo. fr. Jan. 1, or Aug. 1.

Under the terms of this transaction the Debtor is entitled to the use of

1st, £100 for 8 months, =8 times 100 or £800 for 1 mo.
2d, 100 " 6 " =6 " 100 " 600 " 1 "
3d. 100 " 7 " =7 " 100 " 700 " 1 "

a credit equal to £2100 for 1 month; this will evidently entitle the debtor to the use of £300 for as many months as 300 is contained in 2100.

The *product* of any number of *pounds* multiplied by any number of months, and fractions of a month, a Debtor is entitled to use them, is the number of pounds he is entitled to use for 1 month under the same terms, hence the following:—

Rule.—Multiply each debt by its term of credit, divide the sum of the products by the sum of the debts, and the quotient is the equated term.

First study this very simple example thoroughly, make yourself familiar with each operation, the reason for its use, and the causes of the results, and you will then have no difficulty in comprehending the most complex Debtor and Creditor accounts.

BILLS BOUGHT ON EQUAL TIME AT DIFFERENT DATES.

Required the equated time of paying the following bills each bought on 8 months credit.

No of months, from zero date	1878			
	June	0—Zero date.		
	June	9	£180 × .3 =	54
1	July	15	84 × $1\frac{1}{2}$ =	84 42
3	Sept.	14	240 × 3.3$\frac{1}{6}$ =	720 72 40
4	Oct.	10	96 × $4\frac{1}{3}$ =	384 32
			£600	)1428(2.38
				3
				11.4

	mo. da.		yr. mo. da.	
Equated term	2, 11	after	78, 6, 0	zero date.
Plus term of Cr.	8, 0	=	10, 11,	
Equated time			79, 4, 11,	or April 11th, 1879.

Rule,—Multiply each debt by the time—in months and fractions of a month,— between its occurrence and the zero date, divide the sum of the products, by the sum of the debts, and the quotient is the equated term— in months and hundredths of a month,— counting from the zero date, add the term of credit, and the sum is the equated time.

NOTE 1. To reduce hundredths of months to days, multiply by 3, and point off the right hand figure, when the right hand figure in the product is 5 or more add 1 day, otherwise disregard it.

NOTE 2, When the figures representing the day of the month are multiples of 3, such as the 3d, 9th, 27th, &c. &c., multiply by tenths, because 3 days is .1 of a month ; when they are not multiples of 3 then multiply by the simplest fraction, or fractions of a month. In the above example, Sept. 14th,. 3 months 14 days from zero date, we multiply by 3.3$\frac{1}{6}$, 3 months, plus 9 days, plus 5 days. Facility in selecting the simplest fractions for multipliers is easily acquired by practice.

BILLS BOUGHT ON UNEQUAL TIME AT DIFFERENT DATES.

Required the equated time of paying the following bills of goods.

Term of Cr. Mos.	April	0			
6	"	10	To Mdse.	£310 $\times 6\frac{1}{3}$	$=$ 1860 103
2	1 May	21	" "	468×3.7	$=$ 1404 328
4	2 June	1	" "	$520 \times 6\frac{1}{30}$	$=$ 3120 17
3	3 July	8	" "	$750 \times 6.1\frac{1}{6}$	$=$ 4500 75 125

	Mo.	Da.		
Zero date	4	0	2048	)11532(5.63
Equated term	5	19		3
Equated time	9	19 or Sept. 19th.		18.9

Rule—Multiply each debt by the term of credit, plus the time between the date of the transaction and the zero date; divide the sum of the products by the sum of the debts, and the quotient is the equated term.

The figures on the extreme left represent the terms of credit; the figures on the left of the month represent the number of months from the zero date, these together with the day of the month are the multipliers.

	mos.		mos. da.		
1st item	6	Cr. plus	0, 10	from 0 date	$=6\frac{1}{3}$ mos.
2d "	2	" "	1, 21	" " "	$=3.7$ "
3d "	4	" "	2, 1	" " "	$=6\frac{1}{30}$ "
4th "	3	" "	3, 8	" " "	$=6.1\frac{1}{6}$ "

NOTE.—The use of the beginning of the month, instead of the date of the first transaction for the starting point, makes no difference in the ultimate result, and avoids the continual labor of finding on each item, the time between two dates, each date as written, *itself* representing the time.

MONTHLY STATEMENTS.

Find the equated time for paying he following acct'
1878

Jan.	1	To Goods	\$660.00 ×	$\frac{1}{30}$ =	22
	3	" "	841. " ×	.1 =	84
	4	" "	730. " ×	.1$\frac{1}{30}$ =	73 24
	5	" "	786. " ×	$\frac{1}{6}$ =	131
	6	" "	815. " ×	$\frac{1}{5}$ =	163
	8	" "	612. " ×	.1$\frac{1}{6}$ =	61 102
	10	" "	312. " ×	$\frac{1}{3}$ =	104
	11	" "	215.25 ×	$\frac{1}{5}$ $\frac{1}{6}$ =	43 36
	15	" "	118. " ×	$\frac{1}{2}$ =	59
	16	" "	30. " ×	$\frac{1}{3}$ $\frac{1}{5}$ =	10 6
	19	" "	86. " ×	.3$\frac{1}{3}$ =	26 29
	20	" "	66. " ×	$\frac{2}{3}$ =	44
	23	" "	48. " ×	.6$\frac{1}{6}$ =	29 8
	27	" "	100. " ×	.9 =	90
	28	" "	27. " ×	.6$\frac{1}{3}$ =	16 9
	30	" "	48.75 ×	1 =	49
			5495.		)1218(.22
					3
					6.6

Equated time Jan 7th.

Rule,—Multiply each debt by the time between its occurrence and the zero date, divide the sum of the products by the sum of the debts, and the quotient is the equated term

This example is extended for the purpose of introducing every possible fraction of a month, the selection of the simplest fractions for multipliers will become the work of an instant by practice.

NOTE.—Omit the cents when under fifty, add one dollar when they are fifty or more. If English money, use one decimal.

Find the equated time of paying the balance of the following accts

1878			Dr.		1878			Cr.	
Mar.	0				Mar	0			
"	15	3 mos.	$600 \times 3\frac{1}{2} =$	1800 300	2 May	10	By Cash	$300 \times 2\frac{1}{3} =$	600 100
1 Apr.	3	4 "	$700 \times 5.1 =$	3500 70	4 July	1	" "	$400 \times 4\frac{1}{30} =$	1600 13
2 May	10	6 "	$1000 \times 8\frac{1}{3} =$	8000 333	5 Aug	15	" "	$500 \times 5\frac{1}{2} =$	2500 250
			2300	14003				1200	5063

2300   14003
1200   5063
1100   )8940(8.13
3
3.9

Balance due Nov. 4th, 8 mos. 4 days after zero date.

1877			Cr.		1877			Dr.	
June	0			158	June	0			
1 July	4	By Note	$158 \times 1.1\frac{1}{30} =$	16 5	"	20	To Goods	$986 \times \frac{2}{3} =$	329 329
3 Dec.	18	" Md'c	$228 \times 6.6 =$	1368 137	5 Nov.	16	" "	$152 \times 5\frac{1}{3}\frac{1}{5} =$	760 51 30
1878					1878				
9 Mar	5	" "	$450 \times 9\frac{1}{6} =$	4050 75	8 Feb.	26	" "	$110 \times 8.7\frac{1}{6} =$	880 77 18
			836	5809				1248	2474

5809
2474
412)3335(8.09
3
2.7   8 mo. 3da before zero date.

1248
836
412

Zero date   77, 6, 0
Minus   8, 3
76, 9, 27   Balance due Sept. 27th, 1876.

In this example the balance of the products is on the smaller side of the account; when this happens the eqated term is deducted from the zero date to find the equated time.

The credit side has the ADVANTAGE of the use of the equivalent of £3335 for one month, then the other side is entitled to interest on the balance for as many months as 412 is contained in 3335.

Rule.—Multiply each item by the time between its occurrence and the zero date, added to the term of credit—if any— divide the balance of the products by the balance of the account and the quotient is the equated term.

Note,—This rule applies to Partial Payments and all Dr. and Cr. accounts.

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PARTIAL PAYMENTS.

A note is made March 15th, 1878 for €720.
Endorsed April 3d, pd. on account £170
" May 20th, " " " 245
" June 18th " " " 87
from what date must interest be computed on the balance.

Apr,	3	$170 \times 1.1 =$	170, 17	Mar.	15	$720 \times \frac{1}{2} = 360$
2 May	20	$245 \times 2\frac{2}{3} =$	490, 164			502
3 Ju.	17	$87 \times 3.4\frac{1}{6} =$	261, 35, 14			218
		502	1151			
			360			

218)791(3.62 3mos. 19 da. before 0 date.

Zero date 78, 3, 0
Minus 3, 19
Equated time 7, 11, 11 Nov. 11th, 1877.

PAYM'TS MADE ON ACC'T OF A DEBT BEFORE IT IS DUE

1878	Cr.	1878	Dr.
March 1 By Cash	$300	Jan. 1st, to goods on 6 mos.	$1500
May 1 " "	400		

On what date is the balance $800 due.

Jan	1	$1500 \times 6 = 9000$	2 March	1	$300 \times 2 = 600$
		2200	4 May	1	$400 \times 4 = 1600$
		800)6800			700 2200
		$8\frac{1}{2}$			

Ans. $8\frac{1}{2}$ mos. after Jan. 1st, Sept. 15th.

Explanation,—under the terms of this transaction the debtor is entitled to the use of $1500 for 6 months, equal to 6 times 1500 or $9000 for 1 month on paying

$300 in 2 mos. the use of which for that time is=$600 for 1 mo.
400 " 4 " " " " " " " " "= 1600 " 1 "

he has used the equivalent of $2200 for 1 month and is consequently entitled to the use of the balance for a time equal to the use of $6800 for one month.

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The Creditor is entitled to interest on the Balance from the date on which it is due, to the date of settlement. The Debtor is entitled to discount off the Balance for the time he pays it before it is due.

Find the Cash Balance on each of the four preceding acc'ts.

1st,—£1100 due Nov. 4th, settled Aug. 22d, int. at 6 per cent.

	mo. da.			
Balance due	11, 4	Am't of £1		Cash Balance
Date of settlement,	8, 22	mo. da.	1.012	1100=£1086.95. Ans.
Difference,	2, 12	for 2 12		

2d,—£412 due 27 | 9 | 76, date of settlement 27 | 7 | 78. Interest 6 per cent

Yr.	Mo.	Da.
78	7	27
76	9	27
1	10	

Yr. Mo.
Int. for 1, 10, 45.32+ 412=£457.32. Ans.

3d,—£218 due 11 | 11 | 77, date of settlement 5 | 9 | 78 Interest 6 per cent

78	9	5
77	11	11
	9	24

Mo. Da.
Int. for 9 24, 10.68+ 218=£228-68. Ans.

4th,—$800 due 78 | 9 | 15 | date of settlement 78 | 12 | 19 7 Int. per ct

Mo.	Da.
12	19
9	15
3	4

Mo. Da.
Int. for 3, 4, 14.62+$800=$814.62. Ans.

TO FIND THE DIFFERENCE OF TIME BETWEEN TWO DATES.

Rule. Subtract the earlier from the latter date.

Example.—For what time must interest be charged on a debt due the first of May, 1873, and settled on the ninth of March, 1875.

Process,
75 : 3 : 9
73 : 5 : 1
1 : 10 : 8 Ans. 1 yr. 10 mo. 8 days.

NOTE.—To compute on a basis of 365 days to the year, add one day for each month of 31 days; deduct 2 days in the common year, and one day in leap year, for February.

Méthode de Calcul pour l'espace de Trente Siècles.

Règle.—Des deux derniers chiffres de l'an, rejetez tous les sept, tout en retenant le restant; divisez les deux derniers chiffres de l'an par *quatre*, retenant le quotient, sans tenir compte du restant, s'il y en a;—puis prenez le jour du mois, ensuite le chiffre donné pour le mois, et finalement celui pour le siècle. Ayez toujours soin de rejeter les *sept* où il y en a.

Le chiffre 1 (un) restant représente le premier; 2, le second; &c., et O (zéro) le dernier jour de la semaine.

TABLE DES CHIFFRES POUR LES MOIS.

1, Septembre et Déc.	3, Jan. et Oct.	5, Août.	
2, Avril et Juillet.	4, Mai.	6, Fév., Mars, Nov.	0, Juin.

Nota.—Dans l'année bissextile le chiffre pour Janvier est 2, et celui pour Février 5.

TABLE DES CHIFFRES POUR LES SIÈCLES.

1, est le chiffre pour les 2ème, 9ème, et 16ème, siècles.
2, " " " " " 1er, 8ème, 15ème, 18ème, 22ème, 26ème, 30ème, [siècles.
3, " " " " " 7ème, 14ème siècles.
4, " " " " " 6ème, 13ème, 17ème, 21ème, 25ème, 29ème, [siècles.
5, " " " " " 5ème, 12ème, 20ème, 24ème, 28ème, siècles.
6, " " " " " 4ème, 11ème siècles.
0, " " " " " 3ème, 10ème, 19ème, 23ème, 27ème, siècles.

Exemple.—Quel fut le jour de la semaine au 31 Août, 1873? Réponse, Dimanche.

Procédé—

Deux derniers chiffres de l'an,	73—70=3
Quotient de 73 divisé par *quatre*,	18+3—21=0
Jour du mois,	31—28=3
Chiffre pour le mois,	5+3—7=1

Après avoir rejeté tous les *sept* il reste le chiffre 1; ce fut donc, le premier jour de la semaine, Dimanche.

N. B.—Les siècles pairs non-divisibles par le chiffre 400 ne sont pas des années bissextiles.

Mehtode zu sagen den Tag auf die Woche nach jedem Datum von Christi Geburt dreitausend Jahr.

Methode.—Streich die Sieben aus von die beiden letzten Nummern auf das Jahr, der Minuent von den beiden letzten Nummern im Jahre, dividirt bei vier—gebrauche nicht den Rest—den Datum auf den Monat, und die Figur auf das Jahr. Was überbleibt ist der Tag in der Woche, der erste Sonntag, der zweite Montag u. s. w.

Die Figuren vor die Monate.

1 vor Sept. u. Decbr. 3 vor Jan. u. Oct. 5 vor August. 0 vor Juni.
2 vor April und Juli. 4 vor Mai. 6 vor Feb., März, Nov.

Der Datum im Januar und Februar ist ein weniger im Schaltjahr.

Datum auf die Jahre.

1, ist die Figur vor das 2te, 9te und 16te Jahrhundert.
2, " " " " " 1te, 8te, 15te, 18te, 22te, 26te und 30te Jahrhundert.
3, " " " " " 3te, 7te, 14te Jahrhundert.
4, " " " " " 6te, 13te, 17te, 21te, 25te, 29te Jahrhundert.
5, " " " " " 5te, 12te, 20te, 24te, und 28te Jahrhundert.
6, " " " " " 4te nnd 11 Jahrhundert.
0, " " " " " 3te, 10te, 19te, 23te und 27te Jahrhundert.

Exempel.—Welcher Tag in der Woche war der 31. August, 1873? Antwort, Sonntag.

Die letzten beiden Figuren im Jahre,	73 — 70 = 3
Minuent auf do. ÷ bei vier,	18 + 3 — 21 = 0
Datum im Monat,	31 — 28 = 3
Figur auf den Monat,	5 + 3 — 7 = 1

Der Rest 1 zeigt Euch den ersten Tag in der Woche, welcher ist Sonntag.

NOTE.—Between the Julian and the Augustan Calendars there was a difference of ten days in 1583 and of eleven days in 1753. At the present time the difference is twelve days. The latter came into use in Catholic countries in 1583 and in England in 1753.

Howard's California Calendar for Thirty Centuries.

Rule.—Cast all the sevens out of the last two figures of the year; add the remainder to the quotient* of the last two figures of the year, divided by four; take this sum with the day of the month, the figure for the month, and the figure for the century, dropping all the sevens as they occur, one remainder will be the the first day of the week, Sunday; 2, the second, &c.; 0, last day of the week, Saturday.

* Disregard the fraction, if any, in the quotient.

TABLE OF FIGURES FOR THE MONTHS.

1, Sept. and Dec.	3, Jan. and Oct.	5, August.	0, June.
2, April and July.	4, May.	6, Feb., March, Nov.	

Note.—The figure for January is 2, and February 5 in leap year.

TABLE OF FIGURES FOR THE CENTURIES.

1, is the figure for the 2d, 9th, and 16th centuries.
2, " " " " " 1st, 8th, 15th, 18th, 22d, 26th, 30th centuries.
3, " " " " " 7th, 14th centuries.
4, " " " " " 6th, 13th, 17th, 21st, 25th, 29th centuries.
5, " " " " " 5th, 12th, 20th, 24th, 28 centuries.
6, " " " " " 4th, 11th centuries.
0, " " " " " 3d, 10th, 19th, 23th. 27th centuries.

Example.—What day of the week was the 31st August, 1873? Sunday, Ans.

Process—

Last two figures of the year,	$73 - 70 = 3$
Quotient of 73 ÷ by four,	$18 + 3 - 21 = 0$
Day of month,	$31 - 28 = 3$
Figure for the month,	$5 + 3 - 7 = 1$

After casting out the sevens the remainder is 1: hence it was on the first day of the week, Sunday.

N. B.—The even centuries not divisable by 400 are not leap years.

SQUARE AND CUBE ROOT.

1. A square number multiplied by a square number, the product will be a square number.

2. A square number divided by a square number, the quotient is a square.

3. A cube number multiplied by a cube, the product is a cube.

4. A cube number divided by a cube, the quotient will be a cube.

5. If the square root of a number is a composite number, the square itself may be divided into integer square factors; but if the root is a prime number, the square cannot be separated into square factors without fractions.

6. If the unit figure of a square number is 5, we may multiply by the square number 4, and we shall have another square, whose unit period will be ciphers.

7. If the unit figure of a cube is 5, we may multiply by the cube number 8, and produce another cube, whose unit period will be ciphers.

8. If a supposed cube, whose unit figure is 5, be multiplied by 8, and the product does not give 3 ciphers on the right, the number is not a cube.

To prove cube root: from a cube number subtract its root; the remainder will be a multiple of 6.

From a number that is not a cube, subtract the ascertained part of its cube root; divide the difference by 6; then divide the remainder in the example by 6; the excess, if any, should in each case be the same.

TABLE

For comparing the natural numbers with the unit figure of their squares and cubes. By the use of this, many roots may be extracted by observation:

Numbers...	1	2	3	4	5	6	7	8	9	10
Squares....	1	4	9	16	25	36	49	64	81	100
Cubes......	1	8	27	64	125	216	343	512	729	1000

The product of a number taken any number of times as a factor, is called a power of the number.

A root of a number is such a number as taken some number of times as a factor, will produce a given number.

If the root is taken twice as a factor to produce the number, it is the *square root;* if three times, the *cube root;* if four times, the *fourth root.*

By observing the above table, it will be seen that the square of any one of the digits is less than 100, and the cube of any one of the digits is less than 1000; therefore, the square root of two figures cannot be more than one figure.

The square of any number equals its root, plus the preceding square and root of a consecutive series.

$$4^2=16. \quad 4+9+3=16.$$

The units figure in the cube root of a perfect cube is the units figure in the *product* of the units figure of the cube multiplied twice into itself.

Find the cube root of 343.

The units figure $3\times3\times3=27$. Ans. 7.

The difference of the squares of two numbers equals their sum multiplied by their difference.

To find the square root of a number.

RULE 1. Separate the given number into periods of two figures each, beginning at the unit's place.

The number of figures in the root equals the number of periods.

2. Find the greatest number whose square is contained in the period on the left; this will be the first figure in the root. Subtract the square of this figure from the period on the left; to the remainder annex the next period to form a dividend.

3. Divide this dividend, omitting the figure on the right, by double the part of the root already found, and annex the quotient to that part, and also to the divisor; then multiply the divisor thus completed by the figure of the root last obtained, and subtract the product from the dividend.

4. If there are more periods to be brought down, continue the operation in the same manner as before.

NOTE 1. If a cipher occurs in the root, annex a cipher to the trial divisor, and another period to the dividend, and proceed as before.
2. If there is a remainder after the root of the last period is found, annex periods of ciphers, and continue the root to as many decimal places as are required.

EXAMPLE.—Find the square root of 1016064.

```
        1,01,60,64(1008
        1
        ─────────
2008)   016064
         16064
        ─────────
         . . . . .
```

NOTE. The square root of a fraction may be found by extracting the square root of the numerator and denominator separately.

To find the cube root of a number.

RULE 1. Beginning at the units' place, separate the given number into periods of three figures each; the number of figures in the root will be equal to the number of periods.

2. Find the greatest number whose cube is contained in the left-hand period; this will be the first figure in the root; subtract its cube, and to the remainder annex the next period.

3. Multiply the ascertained part of the root by 3, then multiply that result by the first figure in the root, the product with two ciphers annexed is the first trial divisor.

4. Find how many times the divisor is found in the dividend and place the result in the root, and also to the right of the first term in the left hand column; multiply the last result by the new figure in the root and add the product to the trial divisor; the sum is the complete divisor.

5. Multiply the complete divisor by the second figure in the root, subtract the product from the dividend and bring down the next period.

6. To find the next trial divisor add the square of the last found figure in the root to the preceding divisor and its smaller part; to the sum annex two ciphers, complete the divisor as before.

7. Repeat the foregoing process with each period until the exact root, or a sufficient approximation to it is found.

EXAMPLE.—Find the length of one edge of an excavation from which a cubic mass of earth = 1,745,337,664 cubic feet is to be taken. Ans. 1204 feet.

32	300	1,745,337,664(1204, cube root.
	64	1
1st complete divisor,	364	745
	4,320,000	728
3604	14,416	17,337,664
2nd com. divisor.	4,334,416	17,337,664

NOTE 1.—If a cipher occurs in the root, annex two ciphers to the trial divisor and another period to the dividend, and then proceed as before.

2. If there is a remainder, after the root of the last period is found, annex periods of ciphers and proceed as before to as many decimal places as the answer requires.

3. The cube root of a fraction may be found by extracting the cube root of the numerator and denominator.

CASTING OUT THE NINES.

The number nine has many peculiar properties in our system of notation. Any number is divisible by 9 when the sum of its digits is divisible by 9.

Any remainder left after dividing a number by 9, will be left after dividing the sum of its digits by 9.

This peculiarity may be used with advantage in proving the four fundamental rules, by casting out the nines, that is, dropping 9 whenever the sum reaches or exceeds that number, thus to cast the 9s out of 846732, we say 8+4 less 9 leaves 3; 3+6 less 9 leaves 0; 7+5 less 9 leaves 3; hence the following.

To prove ADDITION, cast out the nines from the example, and from the ascertained sum, if correct the excess in each will be the same.

To prove SUBTRACTION, the excess of the remainder should equal the excess in the minuend less the excess in the subtrahend.

NOTE. If the excess in the minuend is less than the excess in the subtrahend, it must be increased by nine.

To prove MULTIPLICATION. The excess of the product, must equal the product of the excess of the factors.

Note. If the multiplier or multiplicand is a multiple of nine, the product will have no excess.

To prove DIVISION. The excess of the dividend must equal the product of the excesses in Quotient and Divisor, plus the excess of the remainder.

MARKING GOODS.

Removing the decimal point one place to the left on the cost of a dozen articles, gives the cost of one article with 20 per cent. added. We remove the point one place to the left, because 12 tens make 120. Hence, to find the selling price, to gain the required percentage of profit, we have the following general rule:

RULE.—Remove the decimal point one place to the left on the cost per dozen, to gain 20 per cent.; increase or diminish to find the percentage, as per following table:

TABLE FOR MARKING ALL GOODS BOUGHT BY THE DOZEN.

To make 20% remove the point 1 place to left.

"	25%	"	"	"	"	Add	$\frac{1}{24}$	itself.
"	26%	"	"	"	"	"	$\frac{1}{20}$	"
"	28%	"	"	"	"	"	$\frac{1}{15}$	"
"	30%	"	"	"	"	"	$\frac{1}{12}$	"
"	32%	"	"	"	"	"	$\frac{1}{10}$	"
"	$33\frac{1}{3}$%	"	"	"	"	"	$\frac{1}{9}$	"
"	35%	"	"	"	"	"	$\frac{1}{8}$	"
"	$37\frac{1}{2}$%	"	"	"	"	"	$\frac{1}{7}$	"
"	40%	"	"	"	"	"	$\frac{1}{6}$	"
"	44%	"	"	"	"	"	$\frac{1}{5}$	"
"	50%	"	"	"	"	"	$\frac{1}{4}$	"
"	60%	"	"	"	"	"	$\frac{1}{3}$	"
"	80%	"	"	"	"	"	$\frac{1}{2}$	"
"	$12\frac{1}{2}$%	"	"	"	"	subtract	$\frac{1}{16}$	"
"	$16\frac{2}{3}$%	"	"	"	"	"	$\frac{1}{36}$	"
"	$18\frac{3}{4}$%	"	"	"	"	"	$\frac{1}{96}$	"

REFERENCE TABLES.

Multiplication Table.

1	2	3	4	5	6	7	8	9	10	11	12
2	4										
3	6	9									
4	8	12	16								
5	10	15	20	25							
6	12	18	24	30	36						
7	14	21	28	35	42	49					
8	16	24	32	40	48	56	64				
9	18	27	36	45	54	63	72	81			
10	20	30	40	50	60	70	80	90	100		
11	22	33	44	55	66	77	88	99	110	121	
12	24	36	48	60	72	84	96	108	120	132	144

Abbreviations used in Business.

@............At.
℀ or Acc't ..Account.
Am't.........Amount.
Ass'd.........Assorted.
Bal...........Balance.
Bbl...........Barrel.
B. L..........Bill of Lading.
% ....Per cent.
Co.............Company.
C. O. D. ..Collect on Delivery.
Cr............Creditor.
Com..........Commission.
Cons't........Consignment.
Cwt......... Hundred Weight.
Dft ....Draft.
Disc't........Discount.
Do............The same
Doz...........Dozen.
Dr.............Debtor.
E. E.........Errors excepted.
Ea......... .Each.
Exch.........Exchange.
Exps.........Expenses.
Fol............Folio.
Fw'd..........Forward.
Fr't...........Freight.
Guar.........Guarantee.
Gal...........Gallon.
Hhd ....Hogshead.
Ins... ....Insurance.
Inst..........This month.
Invt..........Inventory
Int............Interest.
Mdse.........Merchandise.
Mo............Month.
Net..........Without disc't.
No............Number.
Pay't.........Payment.
Pd ....Paid.
Per An. ......By the year.
Pk'gs.........Packages.
Per............By.
£,,s,,d, Pounds, shil'gs, pence.
Prem.........Premium.
Prox........ Next month.
Ps.............Pieces.
Rec'd.........Received.
R. R.........Railroad.
Ship't........Shipment.
Sund's.......Sundries.
S. S ....Steamship.
Ult...........Last month.

Specific Gravity is the weight of a body compared with another of the same bulk taken as a standard. The exact weight of a cubic inch of gold, compared with a cubic inch of water, is called its SPECIFIC GRAVITY. Water is the standard for solids and liquids. A cubic foot of rain water weighs 1000 ounces.

NOTE.—To find the weight, in ounces, of one cubic foot of any substance here named, remove the decimal point three places to the right.

Acid, Acetic	1.008
Acid, Arsenic	3.391
Acid, Nitric	1.271
Air,	.001
Alcohol, of Commerce,	.835
" Pure,	.794
Alderwood,	.800
Ale,	1.035
Alum,	1.724
Aluminum,	2.560
Amber,	1.064
Amethyst,	2.750
Ammonia,	.875
Ash,	.800
Blood, Human,	1.054
Brass, (about)	8.000
Brick,	2.000
Butter,	.942
Cherry,	.715
Cider,	1.018
Coal, bituminous, (about)	1.250
" anthracite,	1.500
Copper,	8.788
Coral,	2.540
Cork,	.240
Diamond,	3.530
Earth (mean of the Globe)	5.210
Elm,	.671
Emerald,	2.678
Ether,	.632
Fat of Beef,	.923
Fir,	.550
Glass plate,	2.760
Gold, hammered,	19.362
" Coin,	17.647
Granite,	2.625
Graphite,	1.987
Gunpowder,	.900
Gum Arabic,	1.452
Gypsum,	2.288
Hazel,	.600
Hematite Ore,	4.705
Honey,	1.456
Ice,	.930
Iodine,	4.948
Iridium,	23.000
Iron,	7.645
" Ore,	4.900
Ivory,	1.917
Lard,	.947
Lead, cast,	11.350
" white,	7.235
Lignum Vitae,	1.333
Lime,	.804
" stone,	2.386
Mahogany,	1.063
Malachite	3.700
Maple,	.750
Marble,	2.716
Men (Living,)	.891
Mercury, pure,	14.000
Mica,	2.750
Milk,	1.032
Naptha,	.700
Nickel,	8.279
Nitre,	1.900
Oak,	1.170
Oil, Castor	.970
Opal,	2.114
Opium,	1.337
Pearl,	2.510
Pewter,	7.471
Platinum Wire,	21.041
Poplar,	.383
Porcelain,	2.385
Quartz,	2.500
Rosin,	1.100
Salt,	2.130
Sand,	1.750
Silver coin,	10.534
Slate,	2.110
Steel,	7.816
Stone,	2.500
Tallow,	.941
Tin,	7.291
Turpentine, spirits of,	.870
Walnut,	.671
Water, distilled,	1.000
Wax,	.897
Willow,	.585
Wine,	.992
Zinc, cast,	7.190

The Diameter of a Circle.	$\times 3.1416$ / $\div .3183$	=The Circumference.
	$\times .8862$ / $\div 1.1284$	=The side of an equal Square.
	$\times .866$ / $\div .1547$	=The side of an inscribed Equilateral Triangle.
	$\times .707$ / $\div 1.4142$	=The side of an inscribed Square.
The Circumference of a Circle.	$\times .3183$ / $\div 3.1416$	=The Diameter.
	$\times .2821$ / $\div 3.545$	=The side of an equal Square.
	$\times .2756$ / $\div 3.6276$	=The side of an inscribed Equilateral Triangle.
	$\times .2251$ / $\div 4.4428$	=The side of an inscribed Square.
	$\times .15915$ / $\div 6.28318$	=The Radius.
The Area of a Circle.	$\div 3.1416$	=The square of Radius.
	$\times 1.2732$ / $\div .7854$	=The square of Diameter.
	$\times 12.5663$ / $\div .07958$	=The square of Circumference.

The Surface of a Sphere =	Circumference $\times$ its Diameter.
	$(\text{Radius})^2 \times 12.5664$
	$(\text{Diameter})^2 \times 3.1416$
	$(\text{Circumference})^2 \times .3183$
The Volume of a Sphere =	Surface $\times$ 1-6 its Diameter.
	$(\text{Radius})^3 \times 4.1888$
	$(\text{Diameter})^3 \times .5236$
	$(\text{Circumference})^3 \times .0169$
The Diameter of a Sphere =	$\sqrt{}$ of Surface $\times .5642$
	$\sqrt[3]{}$ of Volume $\times 1.2407$
The Circum- of a Sphere =	$\sqrt{}$ of Surface $\times 1.77255$
	$\sqrt[3]{}$ of Volume $\times .38978$
The Radius of a Sphere =	$\sqrt{}$ of Surface $\times .2821$
	$\sqrt[3]{}$ of Volume $\times .6204$
The Side of an inscrib'd Cube =	Radius $\times 1.1547$
	Diameter $\times .5774$

TRIANGLES.—The area=the base$\times$half the altitude.

The hypothenuse= $\sqrt{}$of the sum of the squares of the base and the perpendicular.

The base, or perpendicular=the$\sqrt{}$of the difference between the square of the hypothenuse and the square of the given side.

Longitude reckoned from the Meridian of Greenwich.

NORTH AND SOUTH AMERICA.

Place.	Lat.	Long.	Place.	Lat.	Long.
	° ′	° ′		° ′	° ′
Albany, N. Y..	42 40 N	73 45W	Lima, ...	12 3 S	77 6
AnnArb'r,Mich	42 17	83 43	Little Rock, Ark...	34 40 N	92 12
Annapolis, Md.	38 59	76 29	Louisville, Ky.	38 3	85 30
Augusta, Me...	44 19	69 50	Mexico, Mexico....	19 26	99 5
Austin, Texas.	30 13	97 39	Milwaukee, Wis...	43 2	87 54
Baltimore, Md.	39 18	76 37	Mobile, Ala........	30 41	88 1
Bangor, Me....	44 48	68 46	Montreal, C. E.....	45 31	73 33
Boston, Mass..	42 21	71 03	New Haven, Conn..	41 18	72 55
Brooklyn, N. Y.	40 42	73 58	New Orleans, La...	29 58	90 2
Buffalo, N. Y..	42 50	78 59	New York, N. Y...	40 43	74
Burlington, Vt.	44 27	73 10	Ottawa, C. W......	45 23	75 42
Buenos Ayres.	34 36 S	58 22	Philadelphia, Pa...	39 57	75 9
Cambr'ge, Mass	42 23 N	71 08	Petersburg, Va....	37 14	77 24
Cape May, N. J.	38 56	74 57	Portland, Me.......	43 39	70 15
Cape Horn.....	55 59 S	67 16	Providence, R. I...	41 49	71 24
Charleston, S. C	32 47 N	79 56	Quebec, C. E......	46 40	71 12
Chicago, Ill....	41 54	87 38	Richmond, Va.....	37 32	77 26
Cincinnati, O...	39 06	84 30	Rochester, N. Y...	43 8	77 51
Columbia, S. C.	34	81 02	Rio Janeiro........	22 56 S	43 9
Concord, N. H.	43 12	71 29	Savannah, Ga......	32 5 N	81 5
Council Bluffs.	41 30	95 48	Sacramento, Cal...	38 35	121 28
Des Moines, Io.	41 35	93 40	St. August'e, Fla..	29 48	81 5
Detroit, Mich..	42 20	83 2	St. Louis, Mo......	38 37	90 15
Dover, Del.....	39 10	75 30	St. Paul, Minn.....	44 53	95 5
Dubuque, Io...	42 30	90 40	Salt Lake City.....	40 46	112 6
Fred'csb'rg, Va	38 18	77 27	San Francisco.....	37 48	122 47
Fort Laramie..	42 12	104 48	Santa Fe, N. Mex..	35 41	106 1
Ft. L'v'wth, Ks.	39 21	94 44	Springfield, Ill.....	39 48	89 33
Frankfort, Ky..	38 14	84 40	St. Joseph's, Mo...	39 40	94 52
Galveston, Tex	29 18	94 47	Syracuse, N. Y....	43 3	76 9
Georgetown, Bermuda, W. I.	32 22	64 37	Toronto, C. W.....	43 31	79 23
Guayaquil......	2 13 S	79 53	Trenton, N. J......	40 13	74 45
Havana	23 9 N	82 21	Troy, N. Y........	42 44	73 41
Halifax........	44 39	63 35	Valparaiso,........	33 2 S	71 41
Harrisburg, Pa.	40 16	76 50	WASHINGTON	38 53 N	77 0
Hartford, Conn	41 46	72 41	West Point, N. Y..	41 23	73 57
Ind'nap'lis, Ind	39 55	86 5	Wheeling, W. Va..	40 7	80 42
Jeffer' City, Mo	38 36 N	92 8	Wilmington, Del...	34 14	77 57
Key West, Fla,	24 33	81 47	Worcester, Mass...	42 16	71 48
			Yorktown, Va.....	37 13	76 34

A difference of 15 degrees of Longitude equals a difference of one hour of time. The degrees of Longitude between two cities, multiplied by 4, equals, in minutes, the difference of time.

For a difference of	There is a difference of	For a difference of	There is a difference of
15° in Long.	1 hr. in Time.	1° " "	4 min." "
15′ " "	1 min." "	1′ " "	4 sec. " "
15″ " "	1 sec. " "	1″ " "	1-15 sec. in time

EUROPE, ASIA, AFRICA, AND THE OCEANS.

Place.	Lat.	Long.	Place.	Lat.	Long.
	° ′	° ′		° ′	° ′
Antwerp	51 13 N	4 24 E	Leghorn	43 32	10 18 E
Alexandria	31 12	29 53	Leipsic	51 20	12 22
Archangel	64 32	40 33	Lisbon	38 42	9 9 W
Athens	37 58	23 44	Moscow	55 40	35 33 E
Aleppo	36 11	37 10	Malta	35 54	14 30
Algiers	36 47	3 4	Messina	38 12	15 35
Amsterdam	52 22	4 53	Mocha	13 20	43 12
Borneo	5	115	Muscat	23 37	58 35
Botany Bay	34 2	151 13	Marseilles	43 18	5 22
Barcelona	41 23	2 11	Manilla	14 36	121 2
Bombay	18 56	72 54	Madras	14 4	80 16
Bremen	53 5	8 49	Madrid	40 25	3 42 W
Berlin	52 30	13 24	Malaga	36 43	4 26
Brussels	50 51	4 22	New Zealand	34 24 S	173 1 E
Cape Clear	51 26	9 29 W	New Hebrides	15 28	167 7
Calais	50 58	1 51 E	Niphon	34 36 N	138 51
Constantinople	41 1	28 59	Naples	40 50	14 16
Canton	23 7	113 14	Odessa	46 28	30 44
Cronstadt	59 59	29 47	Pekin	39 54	116 28
Copenhagen	55 41	12 34	Palermo	38 8	13 22
Cape of G. Hope	33 56 S	18 29	Paris	48 50	2 20
Calcutta	22 34 N	88 20 E	Rome	41 54	12 27
Corinth	37 54	22 52	Rotterdam	51 54	4 29
Cairo	30 3	31 18	Smyrna	38 26	27 7
Ceylon	9 49	80 23	Singapore	1 17	103 50
Dublin	53 23	6 20 W	Siam	14 55	100
Dover	51 8	1 19 E	Sierra Leone	8 30	13 18 W
Edinburgh	55 57	3 12 W	St. Helena	15 55 S	5 45
Feejee Group	17 41 S	178 53 E	Suez	29 59 N	32 34 E
Florence	43 46 N	11 16	Stockholm	59 21	18 6
GREENWICH	51 29	....	St. Petersburgh	59 56	30 19
Geneva	46 12	6 9	Toulon	43 07	5 22
Glasgow	55 52	4 16 W	Tripoli	34 54	13 11
Gibraltar	36 7	5 22	Tunis	36 47	10 6
Genoa	44 24	8 53 E	Tangier	35 47	5 54
Honolulu	21 19	157 52 W	Venice	45 50	12 26
Hamburg	53 33	9 58 E	Vienna	48 13	16 23
Havre	49 29	6	Warsaw	52 13	21 2
Jerusalem	31 48 N	37 20 W	Zanzibar	6 28 S	39 33
Liverpool	53 25	3			

MEASURE OF CIRCLES, OR ANGLES.

The UNIT is the *degree*, which is 1-360 part of the circumference of any circle.

60 Seconds (″)	= 1 Minute.	′
60 Minutes	= 1 Degree.	°
30 Degrees	= 1 Sign.	S
12 Signs, or 360°	= 1 Circle.	C

And Statute Limitations in the different States.

In some States there are exceptions, and any of the data are liable to change by the action of the State Legislatures.
The English legal rate is 5 per cent.

States and Territories.	Legal rate of Interest.	Rates all'wd by Contract.	Penalties for Usury. Forfeiture of	Statute Limitat'n. Open Acc'ts Yrs.	Note. Yrs.	Judgment. Yrs.
Alabama,..........	8	8	Entire interest	3	6	20
Alaska,...						
Arizona,..........	10	Any.				
Arkansas,.........	6	Any.		3	7	10
California,........	10	Any.		2	4	10
Colorado..........	10	Any.		2	4	5
Connecticut,... ...	6	6	Entire interest	6	6	17
Dakota............	7–10	Any.		6	15	6
Delaware,.........	6	6	Principal	3	6	20
Dist. of Columbia.	6	10	Entire interest	3	3	12
Florida,...........	8	Any.		5	5	
Georgia,..........	7	10	Excess	3	3	12
Idaho,.............	10	Any.				
Illinois,............	6	10	Entire interest	5	6	16
Indiana, ...	6	10	Excess	6	20	20
Indian Territory,..						
Iowa,....	6	10	Entire interest	5	10	20
Kansas,...........	7	12	" "	3	5	10
Kentucky, ...	6	10		2	7	14
Louisiana,.........	5	8	Entire interest	3	5	10
Maine, ...	6	Any.		6	6	20
Maryland, ...	6	6	Excess	3	3	12
Massachusetts,....	6	Any.		6	6	20
Michigan, ...	7	10	Excess	6	6	20
Minnesota, ...	7	12	"	6	6	10
Mississippi, ...	6	10	"	3	6	20
Missouri, ...	6	10	Entire interest	5	10	20
Montana, ...	10	Any.				
Nebraska, ...	10	12	Entire interest	4	5	5
Nevada,...........	10	Any.				
New Hampshire,..	6	6	Thrice excess	6	6	20
New Jersey,.......	7	7	Entire interest	6	16	20
New Mexico,.......	6					
New York, ...	7	7	Excess	6	6	20
North Carolina,....	6	8	Entire interest	3	3	10
Ohio...............	6	8	Excess	6	15	20
Oregon.	10	12		6	6	10
Pennsylvania,......	6	Any.		6	6	20
Rhode Island,......	6	Any.		6	6	20
South Carolina,....	7	Any.		6	6	20
Tennessee,........	6	10	Excess	6	6	10
Texas,............	8	Any.		2	4	10
Utah........	10	Any.				
Vermont, ...	6	6	Excess	6	6	6
Virginia, ...	6	12	"	5	5	10
Washington........	10	Any.				
West Virginia, ...	6	6	Excess	5	5	10
Wisconsin, ...	7	10	Entire interest	10	6	10
Wyoming,........	12					

Paper is bought at wholesale by the bale, bundle and ream; and at retail by the ream, quire and sheet.

24 Sheets = 1 Quire,	2 Reams = 1 Bundle,
20 Quires = 1 Ream.	5 Bundles = 1 Bale.

The names generally define the sizes. Writing and Drawing Papers differ in size from Printing Papers of the same name.

English sizes differ from American.

SIZE OF FOLDED PAPERS, IN INCHES.

Billet Note,	6x8	Letter,	10x16
Octavo Note,	7x9	Commercial Letter,	11x17
Commercial Note,	8x10	Packet Post,	11½x18
Packet Note,	9x11	Extra Packet Post,	11½x18½
Bath Note,	8½x14	Foolscap,	12½x16

FLAT CAP PAPERS.

Law Blank,	13x16	Medium,	18x23
Flat Cap,	14x17	Royal,	19x24
Crown,	15x19	Super Royal,	20x28
Demy,	16x21	Imperial,	22x30
Folio Post,	17x22	Elephant,	22¼x27¾
Check Folio,	17x24	Columbia,	23x33¼
Double Cap,	17x28	Atlas,	26x33
Extra Size Folio,	19x23	Double Elephant,	26x40

SIZE OF PRINTING PAPERS.

Medium,	19x24	Double Medium,	24x38
Royal,	20x25	Double Royal,	26x40
Super Royal,	22x28	Double Super Royal,	28x42
Imperial,	22x32	" " "	29x43
Medium-and-half,	24x30	Broad Twelves,	23x41
Small Double Medium,	24x36	Double Imperial,	32x46

BOOKS.

The terms folio, quarto, octavo, duodecimo, etc., indicate the number of leaves into which a sheet of paper is folded.

When a sheet is folded into	The Book is called	1 sheet of Paper makes	When a sheet is folded into	The Book is called	1 sheet of Paper makes
2 leaves.	A Folio.	4 pages	16 leaves.	A 16mo.	32 pages
4 "	A Quarto or 4to.	8 "	18 "	An 18mo.	36 "
8 "	An Octavo or 8vo.	16 "	24 "	A 24mo.	48 "
12 "	A Duodecimo or 12mo.	24 "	32 "	A 32mo.	64 "

Clerks and Copyists are often paid by the Folio for making copies of legal papers, records and documents.

72 words make 1 folio or sheet of Common Law.

90 " " " " " " " Chancery.

A Folio varies in different States and Countries but usually contains from 75 to 100 words.

GOLD COINS—their weight, fineness, and value in British and United States money, based on U. S. Mint assays, 1879, computed by C. FRUSHER HOWARD.

Country.	Denomination.	Weight.		Fineness.		Value.	
		Grains.	Ounces.	1000ths	Carats.	£ s. d.	U. S. $
Austria,	Union Crown,	171.36	0.357	900.	21.60	1,, 7,, 3½	6.6419
Belgium,	25 Francs,	121.92	0.254	899.	21.57	19,, 4½	4.7203
Bolivia,	Doubloon,	416.16	0.867	870.	20.88	3,, 4,, 1	15.5925
Brazil,	20 Milries,	276.00	0.575	917.5	22.02	2,, 4,, 10	10.9057
Chili,	Doubloon,	416.16	0.867	870.	20.88	3,, 4,, 1	15.5925
Denmark,	10 Thaler,	214.96	0.427	895.	21.48	1,,12,, 5½	7.9000
England,	Sovereign,	123.21	0.2567	916.6	22.00	1,, 0,, 0	4.8665
France,	20 Francs,	99.60	0.2075	899.	21.57	15,,10¼	3.8562
Germany,	20 Marks,	122.90	0.256	900.	21.60	19,, 6½	4.7627
Greece,	20 Drachms,	88.80	0.185	900.	21.60	14,, 1¾	3.4419
India,	Mohur,	179.52	0.374	916.	22.00	1,, 9,, 1	7.0818
Italy,	20 Lire,	99.36	0.207	898.	21.55	15,, 9¼	3.8426
Japan,	5 Yen,	128.30	0.267	900.	21.60	1,, 0,, 5	4.9674
Mexico,	Doubloon,	416.16	0.8675	870.5	20.89	3,, 4,, 1½	15.6105
"	20 Pesos,	518.88	1.081	873.	20.95	4,, 0,, 2	19.5083
Netherl'ds.	10 Guilders,	103.72	0.216	899.	21.57	16,, 5	3.9956
Peru,	Doubloon,	416.16	0.867	868.	20.83	3,, 3,,11¼	15.5567
"	20 Soles,	496.80	1.035	898.	21.55	3,,18,,11½	19.2130
Portugal,	Gold Crown,	147.84	0.308	912.	21.88	1, 3,,10½	5.8066
Rome,	2½ Scudi,	67.20	0.140	900.	21.60	10,, 8	2.6047
Russia,	5 Roubles,	100.80	0.210	916.	22.00	16,, 4	3.9764
Spain,	100 Reales,	128.64	0.268	896.	21.50	1,, 0,, 5	4.9639
Sweden,	Ducat,	53.28	0.111	975.	23.40	9,, 2	2.2372
Turkey,	100 Piasters,	110.88	0.231	915.	21.96	17,,11½	4.3693
United	20 Dollars,	516.00	1.075	900.	21.60	4,, 2,, 2½	20.0000
States.	One Dollar.	25.80	.05375	900.	21.60	.205486	1.0000

The Gold Talent of Scripture—£5864,, 5,,8—$26592.809.
" Silver " " —£ 341,,10,,4—$ 1662.025.
Exactly the existing ratio between U. S. Gold and Silver Coins—16 to 1.

Table of various Silver Coins, showing their weight, fineness and quota of pure silver, computed from U. S. Mint assays, by C. FRUSHER HOWARD.

Country.	Denomination.	Fineness.	Weight.		Pure Silver.	
			Ounces.	Grains.	Grains.	Ounces.
Austria,	New Florin,	.900	0.397	190.56	171.504	.357300
"	" Dollar,	.900	0.596	286.08	257.472	.536400
Belgium,	5 Francs,	.897	0.803	385.44	345.739	.720291
Bolivia,	New Dollar,	.9035	0.643	308.64	278.856	.580950
Brazil,	Double Milries.	.9185	0.820	393.60	361.521	.753170
Canada,	20 Cents,	.925	0.150	72.00	66.666	.138750
Cen. America.	Dollar,	.850	0.866	415.68	353.328	.736100
Chili,	New Dollar,	.9005	0.801	384.48	346.224	.721300
China, Hong K.	English Dollar,	.901	0.866	415.68	374.527	.780266
Denmark,	Two Rigsdaler,	.877	0.927	444.96	390.230	.812979
England,	New Shilling,	.9245	0.1825	87.60	80.986	.168721
France,	5 Franc,	.900	0.800	384.00	345.6	.720000
Germany,	Mark,	.900	0.1785	85.70	77.13	.160650
Greece,	5 Drachms,	.900	0.719	345.12	310.608	.647100
East Indies,	Rupee,	.916	0.374	179.52	164.44	.342584
Japan,	New Dollar,	.900	0.875	420.00	378.000	.787500
Mexico,	" "	.903	0.8675	416.40	376.009	.783352
Naples,	Scudo,	.830	0.844	405.12	336.249	.700520
Holland,	2½ Guilders,	.944	0.804	385.92	364.308	.758976
Norway,	Specie Daler,	.877	0.927	444.96	390.229	.812979
Peru,	Dollar 1858,	.909	0.766	367.68	334.221	.696294
Rome,	Scudo,	.900	0.864	414.72	373.248	.777600
Russia,	Rouble,	.875	0.667	320.16	280.140	.583625
Spain,	New Pistareen,	.899	0.166	79.68	71.632	.149234
Sweden,	Rix Daler,	.750	1.092	524.16	393.120	.819000
Turkey,	20 Piasters,	.830	0.770	369.60	306.765	.639100
Tuscany,	Florin,	.925	0.220	105.60	97.680	.203500
United States.	Dollar	.900	0.8594	412.50	371.25	.7734375
" "	Trade "	.900	0.875	420.00	378.00	.787500

Table showing the value in U. S. Gold Coin of an ounce of silver, (480 gr.) a trade dollar (420 gr.), and a Standard dollar ($412\frac{1}{2}$ gr.), all 9-10 fine, at London quotations for Silver bullion .9245 fine, calculated at the par of exchange, $4.8665, to the pound sterling, by C. FRUSHER HOWARD.

London Quotation Pence.	£ Ster'g	Value of Ounce. 480 Gr'ns	Value of Trade $ 420 Gr.	Value of Stand $ 412½ G	London Quotation Pence.	£ Ster'g	Value of Ounce. 480 Gr's.	Value of Trade $ 420 Gr	Value of Stand. $ 412½ G
		$	$	$			$	$	$
50	.2083	0.9869	0.864	0.848	55¼	.2302	1.0905	.954	.937
50¼	.2094	0.9918	0.868	0.852	55½	.2312	1.0955	.958	.941
50½	.2104	0.9968	0.872	0.856	55¾	.2323	1.1005	.963	.946
50¾	.2115	1.0018	0.877	0.861	56	.2333	1.1055	.967	.950
51	.2125	1.0067	0.881	0.865	56¼	.2343	1.1104	.971	.954
51¼	.2135	1.0117	0.885	0.869	56½	.2354	1.1153	.976	.959
51½	.2146	1.0166	0.889	0.874	56¾	.2365	1.1202	.980	.963
51¾	.2156	1.0215	0.893	0.878	57	.2375	1.1252	.985	.968
52	.2167	1.0264	0.898	0.882	57¼	.2385	1.1301	.989	.972
52¼	.2177	1.0314	0.902	0.887	57½	.2396	1.1350	.993	.976
52½	.2187	1.0362	0.907	0.891	57¾	.2406	1.1399	.997	.980
52¾	.2198	1.0412	0.911	0.895	58	.2417	1.1449	1.002	.985
53	.2208	1.0461	0.915	0.899	58¼	.2427	1.1498	1.006	.989
53¼	.2219	1.0511	0.919	0.904	58½	.2437	1.1548	1.010	.993
53½	.2229	1.0560	0.924	0.908	58¾	.2448	1.1597	1.015	.997
53¾	.2239	1.0610	0.928	0.912	59	.2458	1.1646	1.019	1.001
54	.2250	1.0659	0.932	0.916	59¼	.2469	1.1696	1.023	1.005
54¼	.2260	1.0709	0·937	0.921	59½	.2479	1.1745	1.028	1.010
54½	.2271	1.0758	0.941	0.925	59¾	.2489	1.1794	1.032	1.014
54¾	.2281	1.0807	0.945	0.929	60	.2500	1.1844	1.036	1.018
55	.2292	1.0857	0 949	2.933					

London price per ounce, multiplied by 4.8665, multiplied by .9, divided by .9245, equals the price per ounce, in United States Gold coin.

The Trade dollar is worth two-tenths of a cent more than the Mexican.

HOWARD'S

Tables of Standard Weights and Measures.

A Standard Measure is a fixed unit established by law, by which quantity, as extent, dimension, capacity or value is measured.

The U. S. Standard units are the YARD, the GALLON, the BUSHEL, the TROY POUND, and the GOLD DOLLAR.

The Standard unit of weight must be of definite dimensions, and of definite gravity, of some substance, a certain volume of which, under certain conditions, will always have a certain weight.

One cubic inch of pure water weighed in vacuo, thermometer 62° Fahrenheit, Barometer 30°= 252.458 grains.

5760 grains = 1 Troy pound.

In the Treasury at Washington is a brass scale which. at a temperature of 62° Fahrenheit, is 82 inches long; all our weights and measures are referred to this unit.

Long Measure.

IN.	FT.	YD.	RD.	FUR		
12	1	......	....	.....	..1	Foot.
36	3	1	....	....	..1	Yard.
198	16½	5½	.1	....	..1	Rod.
7920	660	220	40	. 1	..1	Furl'ng
63360	5280	1760	320	..8	..1	Mile.

Surveyors' Long Measure.

IN.	L.	RD.	C.		
7.92	..1	....	...	1	Link.
198	25	..1	...	1	Rod.
792	100	..4	.1	1	Ch'n.
63360	8000	320	80	1	Mile.

The Geographical Mile equals 1.15 Statute Miles,

Comparison of Standard Measures of Distances.

Country.		U. S. Mile.
Austria, ...1 Mile,		= 4.98
China........1 Li,		= .35
East Indies, 1 Coss,		= 1.14
Egypt, ...1 Mili,		= 1.15
England, ...1 Mile,		= 1.00
France, ...1 Kilomet'r.		= .62
Japan, ...1 Ri.		=2.562
Mexico, ...1 Silio,		= 6.76
Persia, ...1 Farsang,		= 4.17
Portugal,.....1 Milha,		= 1.28
Prussia, ...1 Meile,		= 4.93
Russia, ...1 Verst.		= .66
Spain, ...1 League,		= 4.15
Sweden, ...1 Mil,		= 6.64
Switzerland, 1 Lieue,		= 2.98
Turkey, ...1 Berri,		= 1.04

For measuring Land, Boards, Painting, Paving, Plastering, etc.

SQ. INCH.	SQ. FOOT.	SQ. YARD.	SQ. RD.	SQ. R.	SQ. A.		
144	1	....	....	.. ..	......	1	SQ. FT.
1296	9	1	....	......	......	1	YARD.
39204	272¼	30¼	1	......	......	1	ROD.
1568160	10890	1210	40	...1	......	1	ROOD.
6272640	43560	4840	160	4	...1	1	ACRE.
4014489600	27878400	3097600	102400	2560	640	...1	MILE.

In measuring Roofing, Paving, etc., 100 square feet = one square.

One thousand shingles, averaging 4 inches wide, and laid 5 inches to the weather, are estimated to be a square.

One mile square = 1 section = 640 acres. 36 square miles (6 miles square) = 1 township.

The sections are all numbered 1 to 36, commencing at the north-east corner, thus:

6	5	4	3	2	NW | NE SW | SE
7	8	9	10	11	12
18	17	16*	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

The sections are all divided into quarters, which are named by the cardinal points, as in section 1. The quarters are divided in the same way. The description of a forty-acre lot would read: The south half of the west half of the south-west quarter of section 1 in township 24, north of range 7 west, or as the case might be; and sometimes will fall short, and sometimes overrun the number of acres it is supposed to contain.

COMPARISON OF THE COMMON AND METRIC SYSTEMS.

1 Inch, = 2.54 Centimeters
1 Foot, = 30.48 Centimeters
1 Yard, = 9144 Meters
1 Rod, = 5.029 Meters
1 Mile, = 1.6093 Kilometers
1 Sq. in. = 6.4528 Sq. Centim't'rs
1 Sq. ft.. = 929 Sq. Centimeters
1 " yard, = 8.361 Sq. Meters
1 " rod = 25.29 Centairs
1 Acre, = 40.47 Ares.
1 Sq. mile, = 269 Hectares

1 Cu. in. = 16.39 Cu. Centim't'rs
1 " ft.. = 28320 " "
1 " yd., = .7646 " Meters.
1 Cord, = 3.625 Steres
1 Fl. ounce, = .2.958 Centiliters
1 Gallon, = 3.786 Liters
1 Bushel, = .3524 Hectoliter
1 Troy gr. = 64.8 Milligrams
1 " lb. = .373 Kilo
1 Av. lb. = .4536 "
1 Ton, = .907 Tonneau

For measuring timber, stone, boxes, packages, capacity of rooms, etc.

CU. IN.	CU. FT.	CU. YD.	CD. FT	CD.	PCH.		
1728	1	....	......	......	......	1	Cubic Foot.
46656	27	1	......	......	......	1	Cubic Yard.
27648	16	16-27	1	......	......	1	Cord Foot.
221184	128	4 20-27	8	1	......	1	Cord of Wood.
42768	24¾	....	......	......	1	1	Perch of Stone.
69120	40	....	......	......	......	1	U.S.Ton, Ship Cargo

One ton of square timber = 50 cubic feet.

The English shipping ton = 42 cu. ft. The Register ton = 100 cu. ft.

A cord of wood is a pile 4 ft. high, 4 ft. wide, and 8 ft. long.

A cord foot is one foot in length of such a pile.

A cubic yard of common earth is called a load.

In Board measure all boards are assumed to be 1 inch thick.

A board foot is 1 ft. long, 1 ft. wide and 1 in. thick, hence 12 board feet make 1 cubic foot.

Board feet are changed to cubic feet by dividing by 12.

Cubic feet are changed to Board feet by multiplying by 12.

Masonry is estimated by the CUBIC FOOT and PERCH; also by the SQUARE FOOT and SQUARE YARD.

Five courses of bricks in the height of a wall are called a foot,

In board and lumber measure, estimates are made on 1 inch in thickness; one-fourth the price is added for every ¼ inch in thickness over one inch.

MISCELLANEOUS WEIGHTS AND MEASURES.

12 Units,............. 1 Dozen.
12 Dozen,............. 1 Gross.
12 Gross,....... 1 Great Gross.
20 Things,............. 1 Score.
196 lbs...... 1 Barrel of Flour.
200 " ..1 Bbl. Beef, Pork, Fish.
56 " ..... 1 Firkin of Butter.
14 " .... 1 Stone, Avoir.
28 "........... 1 Quarter, "
21½ Stones,..... 1 Pig of Iron.

8 Pigs,................ 1 Fother.
2 Weys (328 lb) 1 Sack of Wool.
12 Sacks, (4368 lb.)..... 1 Last.
3 Inches,.............. 1 Palm.
4 " .... 1 Hand.
9 " .... 1 Span.
3 ft.............1 common pace.
6 " .... 1 Fathom.
3 Miles,.............. 1 League.
360 Degrees,.......... 1 Circle.

TROY WEIGHT.

For Gold, Silver, Jewels, etc.

Gr.	Pwt.	Oz.		
24	...1	....	..1	*Pennyweight*
480	20	..1	..1	*Ounce.*
5760	240	12	..1	*Pound.*

AVOIRDUPOIS WEIGHT.

For Groceries, Provisions, etc.

Gr.	Oz.	Lb.		
437½	1	......	..1	*Ounce*
7000	16	1	..1	*Pound.*
14000000	32000	2000	..1	*Ton.*

The Standard unit is the Troy Pound.

The Long Ton = 2240 lbs. 1 cwt. = 112 lbs.

To compare Troy weights with Avoirdupois, reduce both to grains.

Pounds Avoirdupois × 100×7÷48= ounces Troy.

Troy ounces ×.06 6-7= Pounds avoirdupois; that is, ounces multiplied by .06+1-7 of the product.

APOTHECARIES' WEIGHT.

GRS.	SC. ℈	DR. ʒ	OZ. ℥		
20	..1	....	....	..1	SCRUPLE.
60	3	..1	....	..1	DRAM.
480	24	8	..1	..1	OUNCE.
5760	288	96	12	..1	POUND.

APOTHECARIES' MEASURE.

60 Minims = 1 Fluid Drachm.

8 Fl. Drms = 1 Fluid Ounce.

16 Fl. Ozs. = 1 Pint.

8 Pints = 1 Gallon.

Used in compounding liquid medicines.

The grain, ounce and pound are the same as Troy Weight.
Drugs are bought and sold in quantities by Avoirdupois Weight.
1 Teaspoon = 45 Drops. 1 Tablespoon = ½ Fluid Ounce.

COMPARISON OF LIQUID MEASURES.

Country.		U.S. Gals.
England, ...1	Gallon.	= 1.2
France, ...1	Dekaliter.	=2.64
Prussia, ...1	Quart,	= .30
Austria, ...1	Maas,	= .37
Sweden. 1	Kanna,	= .69
Denmark, ...1	Kande,	= .51

Country.		U. S. Gals.
Switzerland, 1	Pot,	= .40
Turkey, ...1	Almud,	= 1.38
Mexico, ...1	Fasco.	= .63
Brazil, ...1	Medida.	= .74
Cuba.........1	Arroba.	= 4 01
South Spain, 1	Arroba.	= 4.25

COMPARISON OF GRAIN MEASURES.

Country.		U. S. Bushels.
England, ...1	Bushel.	= 1.031
France, ...1	Hectoliter	=2.84
Prussia, ...1	Scheffel,	= 1.56
Austria, ...1	Metze.	= 1.75
Russia 1	Chetverik	= .74
Greece, ...1	Kailon,	=2.837

Country		U. S. Bushels.
Germany, ...1	Schef.	= 1.5 to 3
Persia, ...1	Artaba,	= 1.85
Turkey, ...1	Kilo,	= 1.03
Brazil. 1	Fan.	= 1.5
Mexico, ...1	Alque.	= 1.13
Madras, ...1	Parah,	=1.743

COMPARATIVE TABLE OF POUNDS IN DIFFERENT COUNTRIES

Austria, 100 lbs.	123.50 U. S.	Nederland, 100 lbs.	108.93 U. S.
Bavaria, "	123.50 "	Portugal, "	101.19 "
Belgium, "	103.35 "	Prussia, "	110.25 "
Bremen, "	110.12 "	Russia, "	90.00 "
Berlin, "	103.11 "	Spain, "	101.44 "
Denmark, "	110.00 "	St. Domingo, "	107.93 "
Ger. Zoll. States,	110.25 "	Trieste, "	123.60 "
Hamburg,	110.04 "		

COMPARISON OF COMMERCIAL WEIGHTS.

Country.	Weight.	U. S. Lbs.	Country.	Weight.	U. S. Lbs.
Austria	1 Pfund.	= 1.23	Mexico,	1 Libra,	= 1.02
Arabia,	1 Maund.	= .3	Madras,	1 Vis.	= 3.125
Brazil,	1 Arratel,	= 1.02	Persia,	1 Rattel,	= 2.116
China	1 Catty.	= 1.33	Russia,	1 Funt,	= .90
Denmark.	1 Pund.	= 1.10	Sweden,	1 Pund,	= .93
East Indies.	1 Seer.	= 2.06	Spain,	1 Libra,	= 1.016
Egypt,	1 Rottoli,	= 1.008	Sicily.	1 "	= .7
France,	1 Kilogram.	= 2.20	Turkey.	1 Oka,	= 2.82
Germany,	1 Pfund,	= 1.10	Japan,	1 Kin,	= .62

	Troy.	Apothecaries.	Avoirdupois.
1 Pound	= 5760 grains	= 5760 grains	= 7000 grains.
1 Ounce	= 480 "	= 480 "	= 437.5 "
	175 Pounds	= 175 pounds	= 144 pounds.

RAILROAD FREIGHT.—TABLE OF GROSS WEIGHTS.

When the actual weights are not known, the articles are billed as per the following table.

Ale and Beer,	320 lb. per bbl.		Lime,	200 lb. per bbl.	
" " "	170 " " ½ "		Malt,	38 " " bu.	
" " "	100 " " ¼ "		Millet,	45 " " "	
Apples, dried,	24 " " bu		Nails,	108 " " keg.	
" green,	50 " " "		Oil,	400 " " bbl.	
" "	150 " " bbl.		Peaches, dried,	33 " " bu.	
Beef,	320 " " "		Pork,	320 " " bbl.	
Bran,	20 " " bu.		Potatoes (com.)	150 " " "	
Brooms,	40 " " doz.		Salt, Fine,	300 " " "	
Cider,	350 " " bbl.		" Coarse,	350 " " "	
Charcoal,	22 " " bu.		" in Sack,	200 " " "	
Eggs,	200 " " bbl.		Turnips,	56 " " bu.	
Fish,	300 " " "		Vinegar,	350 " " bbl.	
Flour,	200 " " "		Whiskey,	350 " " "	
Highwines,	350 " " "		One Ton Weight,	2000 lb.	

CU.FT.	CU. IN.		CU.FT.	CU. IN.	
.0167	28.875	4 Gills,..1 Pint.	11.22	19404	2 Tiecs..1 Punsh'n.
.0334	57.75	2 Pints..1 Quart.	4.2109	7276.5	31½ Gals.....1 Bbl.
.1331	231	4 Qts.,..1 Gallon.	8.421	14553	2 Bbls.......1 Hhd.
1.331	2310	10 Gals...1 Anker.	16.84	29106	2 Hhds......1 Pipe.
2.406	4158	18 Gals...1 Runlet.	33.68	58212	2 Pipes......1 Tun.
5.614	9702	42 Gals...1 Tierce.			

The U. S. Standard Gallon contains 231 cubic in.—8⅓ lbs. avoirdup's.
" Imperial " " 277.274 " =1.2 U. S. gallons.
" old Beer Measure " " 282 "

In measuring tanks, reservoirs, etc., it will be sufficiently accurate to regard one cubic foot=7½ U. S. or 6¼ Imperial gallons.

The contents of a circular tank, in barrels of 31½ gallons,=the square of the diameter (in ft.) multiplied by the depth, mul. by .1865.

DRY MEASURE, U. S. STANDARD,

For measuring Grain, Fruit, Roots, Coal, etc.

CU. FT.	CU. IN.	PT.	QT.	GAL.	PK.	BU.	CM.	QR.		
.01944	33.60	1	......	......	....	....	....	....	..1	Pint.
.03888	67.20	2	1	......	....	....	....	....	..1	Quart.
.1555	268.80	8	4	1	....	....	....	....	..1	Gallon.
.3111	537.60	16	8	2	..1	....	....	....	..1	Peck.
1.2444	2150.42	64	32	8	4	..1	....	....	..1	Bushel.
4.9778	8601.68	256	128	32	16	4	..1	....	..1	Coomb.
9.9556	17203.36	512	256	64	32	8	2	..1	..1	Quarter.
39.8225	68813.44	2048	1024	256	128	32	8	4	..1	Chaldron.
44.8004	77415.12	2304	1152	288	144	36	OF	COAL	..1	Chaldron.

The U. S. Standard Bushel contains 2150.42 cubic inches.
The Imperial English " " 2218.192 " "
A cylinder 18½ inches in diameter, 8 inches deep= 1 Bushel.
5 Stricken measures= 4 heap measures.

U. S. Bushels × 1.03152; the product will be Imperial Bushels.

Imperial Bushels ÷ 1.03152; the quotient will be U. S. Bushels.

Any three factors that will produce the number of inches in a given quantity, will be the inside dimensions of a box to hold that quantity; hence a box 11.2×16×12 in., will contain 1 Standard Bushel. 924 cu. inches = 4 Liquid Gallons; therefore a box 12×7×11 inches will contain 4 gallons.

An open box made with the greatest economy of material; the altitude= the radius of the Base; if with a cover the altitude= the base.

A cubic foot = 8-10 of a bushel, nearly; add .44 of a bushel for each 100 bushels.

The number of bushels + ¼ = the number of cubic feet.

The number of cubic feet—1-5=the number of Bushels.

TABLE OF AVOIRDUPOIS POUNDS IN A BUSHEL,

As prescribed by statute in the several States named.

Commodities.	*Cal.*	*Conn.*	*Ill.*	*Ind.*	*Ia.*	*Ky.*	*La.*	*Me.*	*Mass.*	*Mich.*	*Minn.*	*Mo.*	*N. J.*	*N. Y.*	*O.*	*Ore.*	*Penn.*	*R. I.*	*Vt.*	*W. T.*	*Wis.*
Barley,	50		48	48	48	48	32		46	48	48	48	48	48	48	46	47		46	45	48
Beans,			60	60	60	60						60		62							
Blue Grass S'd			14	14	14	14						14									
Buckwheat,	40	45	40	50	52	52			46	42	42	52	50	48		42	48		46	42	42
Castor Beans,			46	46	46							46									
Clover Seed,			60	60	60	60				60	60	60	64	60	60	60				60	60
Dried Apples,			24	25	24					28	28	24				28				28	28
Dried Peaches,			33	33	33					28	28	33				28				28	28
Flax Seed,			56	56	56	56						56	55	55	56						56
Hemp Seed,			44	44	44	44						44									
Indian Corn,	52	56	52	56	56	56	56		56	56	56	52	56	58	56	56	56		56	56	56
Corn, in ear,			70	68	68																
Corn Meal,			48	50		50		50	50									50			
Oats,	32	28	32	32	35	33⅓	32	30	30	32	32	35	30	32	32	34	32		32	36	32
Onions,			57	48	57	57			52			57						50		50	
Potatoes,		60	60	60	60	60		60				60	60	60		60		60	60	60	60
Rye,	54	56	54	56	56	56	32		56	56	56	56	56	56	56	56	56		56	56	56
Rye Meal,								50	50									50			
Salt,				50	50	50						50		56							
Timothy Seed,			45	45	45	45						45		44							46
Wheat,	60	56	60	60	60	60	60		60	60	60	60	60	60	60	60	60		60	60	60
Wheat Bran.			20		20	20						20									

The price per cental = the price per bushel × 100÷the number of pounds in the bushel. *See page 45.*

SEC.	MIN.	HRS.	DA.	WK.		
60	1	......	......	....	..1	Minute.
3600	60	1	......	....	..1	Hour,
86400	1440	24	1	....	..1	Day,
604800	10080	168	7	..1	..1	Week,
31536000	525600	8760	365	52	..1	Common Year,
31622400	527040	8784	366	....	..1	Leap Year.

12 Calender months = 13 lunar months = 1 year.

365 days, 5 hrs. 48 minutes, 50 seconds = 1 Solar year.

10 years = 1 decade. 10 decades = 1 century.

400 years = 146,097 days, a number exactly divisible by 7.

The civil day begins and ends at 12 o'clock, Midnight.

The Astronomical day begins and ends at 12 o'clock, Noon.

As the year contains 365¼ days, nearly, we reckon three years in every four as containing 365 days, and the fourth, leap year, as containing 366 days; the leap year is always a multiple of 4.

The even centuries not divisable by 400 are not leap years.

Formerly the new year began on the 25th of March and was so reckoned in England until 1753.

In ordinary business computations, 1 year = 12 mos. = 360 ds. 1 month = 30 days.

+1	−2	+1		+1		+1	+1		+1		+1
Jan.	Feby.	Mar.	Apl.	May,	June,	July,	Aug.	Sept.	Oct.	Nov.	Dec.

In the common year February has two days less than 30, in leap year 1 day less; seven months have one day more.

To find the exact number of days between two dates.

Multiply the number of entire months by 3, call the product tens; add the extra days, and 1 day for each month of 31 days; when Feb'y occurs, deduct 2 days for the common, and 1 day for Leap year.

How many days from 1st of the 4th month to 9th of the 11th month. 11 mo.—4 mo. = 7 mo. $7 \times 30 + 9 + 4 = 223$ days.

DIAMOND WEIGHT.		ASSAYERS' WEIGHT.	
16 Parts	= 1 Grain.	240 Grains	= 1 Carat.
4 Grains	= 1 Carat.	2 Carats	= 1 Ounce.
1 Carat	= 31-5 Troy grs. (nearly.)	24 Carats	= 1 Pound.

The term Carat is also employed in estimating the fineness of Gold and Silver; when perfectly pure the metal is said to be "24 Carats fine." English Gold coin is 22 carats fine, that is, it consists of 22-24 pure gold, and 2-24 alloy.

To compute the fineness in thousandths, and the weight in ounces and thousandths is simpler, and admits of very minute subdivisions with great facility.

The coining of gold or silver does not change the REAL value of either; it stamps each piece of metal with a national, official certificate of its weight and fineness.

From one Troy pound of gold 22 carats, or .916 2-3 fine 46 29-40 Sovereigns are made, each weighing 123.27448 grains = 113.001605 grains of fine gold = $4.866563.

1 ounce of U. S. Standard Gold	= $18.60465	= £3.8230	= £3,,16,, 5½
1 " " British " "	= 18.94918	= 3.8938	= 3,,17,,10½
1 " " Pure "	= 20.67184	= 4.248	= 4,, 4,,11½

Thousandths of an ounce ÷ 100 × 48 = grains.

Grains × 100 ÷ 48 = thousandths of an ounce.

U. S. Standard ounces of Gold ÷ .05375 = U. S. Dollars.

U. S. Gold Dollars × .05375 = Standard ounces.

To multiply by .05375, remove the point one place to the left and divide by 2, divide this quotient by 20, and the second quotient by 2; the sum of the quotients is the answer.

EXAMPLE.—How many ounces in one U. S. Gold dollar?

```
 2 | .1
   |------
20 | .05
 2 | .0025
   | .00125
   |------
   | .05375
```

Ans. .05375 ozs.

The weight of gold, in ounces, and the fineness being given, to find its value in U. S. Gold Coin.

RULE.—Multiply the weight by twice the fineness, multiply by 10 and divide the product by 30, and the quotient by 129; the sum of the product and the quotients is the answer.

EXAMPLE.—Find the value of one ounce of gold 9-10 fine.

```
 30 | 18.
129 |    .6
    |    .00465
    |----------
    | 18.60465
```

Ans. $18.60465.

Or multiply the given weight by the fineness × 1000 × 8, and divide the product by 387.

$$\overline{1 \times .9 \times 1000 \times 8} \div 387 = 18.60465.$$

The fineness and weight of Silver being given, to find its value in U. S. Silver dollars 9-10 fine, 412½ grains weight.

RULE.—For pure silver, if in grains, divide by 9×10×11×3 and multiply by 8, or divide by .9×412.5.

EXAMPLE.—Pure silver, grains 371.25×8÷9×10×11×3= $1.

If in ounces, divide the weight and fineness by .9 × .895375.

Or multiply the given weight by the fineness and by 1.28; repeat the figures in the product, under, and two places to the right, as often, and to as many decimal places as the answer requires; the sum is the answer.

EXAMPLE.—Find the value in silver dollars of 1 oz. of silver 9-10 fine.

$$\begin{array}{r} 1 \times .9 \times 1.28 = 1.152 \\ 1152 \\ 1152 \\ \hline \$1.1636352 \end{array} \text{ Ans.}$$

To make a compound of any weight and fineness.

RULE. Divide the fineness sought by the fineness to be alloyed; the quotient is the weight required to make a compound of one ounce of the desired fineness.

EXAMPLE.—Required to make a compound of one ounce 14 carats fine by alloying gold 22 carats fine.

14 ÷ 22 = .63636 gold + .36364 alloy = 1 ounce.

To find how many ounces of a lower fineness must be added to one ounce of a higher fineness to make a compound of any given fineness.

RULE.—Divide the difference of the two higher by the difference of the two lower finenesses.

EXAMPLE.—Required a compound of 14 Carats fine by mixing 12 carat fine with 21 carat fine.

$$\frac{21 - 14 = 7}{14 - 12 = 2} = 3\tfrac{1}{2}.$$ 3½ oz. 12 fine + 1 oz. 21 fine = 4½ oz. 14 Carat fine.

The silver dollar weighs 412½ grains, nine-tenths of which is pure silver. At the English mint, a mixture of 11 ozs., 2 pwts. of pure silver, with 18 pwts. of alloy, is coined into 66 shillings. When English coin silver is worth 54 pence an ounce, in gold, and the pound stg. (gold) is worth $4,86 in United States gold, what is the value in U. S. gold coin of the silver contained in the dollar? (The value of the alloy in the English silver is not to be considered.

11 ozs., 2 pwts. $= \frac{222}{240} =$ .925 of an ounce. Ans. 89½ cts.

54 pence = £0.225. .225×4.86 = 1.0935. $\frac{1.0935 \times 412.5 \times .9}{480 \times .925} = .895$

Estimate, in Millions, from the latest official data, of the Population, Imports and Exports, National Debts, and present stock of Gold and Silver Coin and Bullion in the world, in U. S. dollars :

Country.	*Pop.*	*Impts*	*Expts*	*Debt.*	*Gold.*	*Silver.*
United States,............	45	466	739	2256	245	85
Other American States,...	40	243	268	1250	50	50
France, ...	37	892	961	3750	1300	350
Great Britain and Colonies	40	2109	1397	4308	650	100
Germany, ...	40	918	608	86	225	175
Other European States, ...	200	1790	1429	9418	300	300
China, ...	400	105	114	11	50	800
British India, ...	240	244	325	694	100	500
Japan, ...	33	24	27	349	40	10
Other Asiatic States,......	65	45	75		50	200
Africa and the Islands, ...	65	85	100	450	50	20
Total,	1,205	6,921	6,043	22,572	3,060	2,590

Municipal and other public debts are not here included. The city of Paris owes $459,000,000 ; United States cities, $550,000,000.

The quantity of Gold and Silver in the form of Plate is perhaps equal to that in the form of Coin and Bullion.

The product of the Gold and Silver mines of the world last year was about $170,000,000 ; the mines of the United States furnished : Gold, $47,000,000; Silver, $46,000,000.

Approximate Value of Various Metals,

PER POUND AVOIRDUPOIS.

Indium, ...	$2522	£518,, 4,, 9
Vanadium, ...	2510	515,,15,, 5
Ruthenium, ...	1400	287,,13,, 7
Rhodium	700	143,,16,,10
Palladium, ...	653	134,, 3,, 8
Uranium, ...	576	118,, 7,, 3
Titanium, ...	500	102,,15,,
Osmium, ...	325	66,,15,, 9
Iridium, ...	317.44	65,, 4,, 6
Gold	301.46	61,,18,,11
Platinum	115.20	23,,13,, 5
Thallium	108.77	22,, 7,, 0
Chromium, ...	58.00	11,,18,, 3
Magnesium, ...	46.50	9,,11,,
Potassium, ...	23.00	4,,14,, 6
Silver, ...	$18.85	£3,,17,, 6
Cobalt, ...	7.75	1,,11,,10
Cadmium, ...	6.00	1,, 4,, 8
Bismuth, ...	3.63	0,,15,, 0
Sodium, ...	3.20	0,,13,, 0
Nickel, ...	2.50	0,,10,, 3
Mercury, ...	1.35	0,, 5,, 6
Antimony, ...	.36	0,, 1,, 6
Tin, ...	.33	0,, 1,, 4
Copper, ...	.25	0,, 1,, 0
Arsenic, ...	.15	0,, 0,, 7
Zinc	.11	0,, 0,, 5
Lead, ...	.07	0,, 0,, 3
Iron, ...	.02	0,, 0,, 1

MISCELLANEOUS.

How many strokes does a clock strike in 12 hours?

$$\frac{\overline{12+1}\times 12}{2}=78 \text{ strokes.}$$

How many barrels in a triangular pile, 49 barrels at the base and 1 at the top?

$$\frac{\overline{49+1}\times 49}{2}=1225 \text{ barrels.}$$

O'Leary with ten tramps have two days start, and make 8 miles a day; how long will it take Rowell with 5 trampers travelling 10 miles a day to overtake O'Leary and his men?

$$16\div 2=8 \text{ days.}$$

The sum of two numbers is 140; the larger is to the smaller as 1 to $\frac{5}{9}$, what are the numbers?

$$\frac{9}{9}+\frac{5}{9}=\frac{14}{9} \qquad \left.\begin{array}{l} 140\times \frac{9}{14}=90 \\ 140\times \frac{5}{14}=50 \end{array}\right\}=140$$

A Bin 9 ft. 6 in. long, 6 ft. wide, 4 ft. 3 in. deep, will hold how many Imperial bushels.

$$\tfrac{19}{2}\times\tfrac{6}{1}\times\tfrac{17}{4}\times\tfrac{8}{10}-4.845= 188.955 \text{ bushels. Ans.}$$

NOTE. The imperial bushel is 2218.192 Inches, ten eighths of a foot, nearly, deduct $2\frac{1}{2}$ from every 100 bushels in the product, this result multiplied by 8 will be the number of Imp. gallons,

What is the cost of 732 lbs. of Coal at \$14. per ton, 2240 lbs. to the ton?

$$\frac{732\times 14}{8\times 4\times 7}=\$4.575. \text{ Ans}$$

A bin 9 ft, 6 in. long, 6 ft. wide, and 4 ft. 3 in. deep is full of wheat, what is its value at \$2.05 a bushel?

$\frac{19}{2} \times \frac{6}{1} \times \frac{17}{4} \times \frac{8}{10} + .87 \times 2.05 = \$399.07.$ Ans.

Note. The standard bushel is 2150.42 inches; ten-eighths of a foot, nearly, the difference is .44 bu. in each 100. *R*.259,

Divide £1 into 3 parts in the proportion of A, $\frac{1}{2}$, B, $\frac{1}{3}$, C, $\frac{1}{4}$.

$$\frac{6+4+3=13.}{12}$$

Ans. $\frac{6}{13}$, $\frac{4}{13}$, $\frac{3}{13}$.

How many cubic feet in a case 3 ft. 6 in. by 2 ft. 8 in. by 1 ft. 10 in?

$\frac{7}{2} \times \frac{8}{3} \times \frac{11}{6} = 17\frac{1}{9}$ ft. Ans.

If 7 cats, kill 7 rats, in 7 minutes, how many cats will kill 100 rats in 50 minutes?

$$\frac{7 \times 7 \times 100 = 14.}{7 \times 50}$$

Ans. 14 cats.

If it cost \$24 to carry 6 tons 20 miles, what will it cost to carry 12 tons 120 miles?

$$\frac{24 \times 12 \times 120 = 288.}{6 \times 20}$$

Ans. \$288.

How many bricks will pave a walk 200 ft. long, by16 feet; bricks 8 in., by 4 in?

$$\frac{200 \times 16 \times 3 \times 3}{2 \times 1} = 14,400.$$

Ans. 14400 bricks.

Multiply £19 19s. $11\frac{3}{4}$d by $19\frac{19}{20}\ \frac{11}{240}\ \frac{3}{960}$.

$£19,,19,,11\frac{3}{4} - £\frac{1}{960} \times 20 + £(\frac{1}{960})^2 =$

$£399\ \frac{19}{20}\ \frac{2}{240}\ \frac{1}{921600}$

or $£19,,19,,11\frac{3}{4} \times 20 - \frac{1}{960} = £399,,19,,2\ \frac{1}{960}$ of a farthing.

Multiply 66 by $\frac{2}{3}$: $22\ \frac{\cancel{66} \times 2}{\cancel{3}} = 44.$

Divide 66 by $\frac{2}{3}$: $33\ \frac{\cancel{66} \times 3}{\cancel{2}} = 99.$

Divide $168 \times 2 \times 7$ by 7×3: $\frac{\cancel{7} \times 2 \times \overset{56}{\cancel{168}}}{\cancel{7} \times \cancel{3}} = 112.$

Divide £99 amongst 3 persons, A to have $\frac{5}{11}$, B $\frac{4}{11}$, and C $\frac{2}{11}$.

$\cancel{11} \left| \begin{array}{l} \cancel{99}\ 9 \\ 5 \end{array} \right.$ $\cancel{11} \left| \begin{array}{l} \cancel{99}\ 9 \\ 4 \end{array} \right.$ $\cancel{11} \left| \begin{array}{l} \cancel{99}\ 9 \\ 2 \end{array} \right.$ A £45, B £36, C £18.

Two merchants load a ship with goods worth £5000, A owns £3500, and B the rest; the goods suffer damage valued at £1000, what is each man's share of the loss?

$5\cancel{000} \left| \begin{array}{l} 1\cancel{000} \\ 3500 \end{array} \right.$ $5\cancel{000} \left| \begin{array}{l} 1\cancel{000} \\ 1500 \end{array} \right.$ A loses £700.
B ,, £300.

B and C gain by trade £182; B put in £300, and C £400, what is the gain of each?

$7\cancel{00} \left| \begin{array}{l} 3\cancel{00} \\ 182 \end{array} \right.$ $7\cancel{00} \left| \begin{array}{l} 4\cancel{00} \\ 182 \end{array} \right.$ B £78.
C £104.

A person owning $\frac{3}{5}$ of a mine sells $\frac{3}{4}$ of his share for £1710, what is the value of the whole mine?

$$190\ \frac{\cancel{1710} \times 4 \times 5}{\cancel{3} \times \cancel{3}} = £3800.$$

How much money will buy $\frac{3}{4}$ of $\frac{3}{5}$ of a mine worth £3800?

$\frac{3}{5} \times \frac{3}{4} = \frac{9}{20}$ $\frac{3800 \times 9}{20} = £1710.$

If $\frac{1}{3}$ of 6 be 3, what will $\frac{1}{4}$ of 20 be?

$$\frac{3 \times \cancel{3} \times \cancel{20}\ 5}{2\ \cancel{6} \times \cancel{4}} = 7\tfrac{1}{2}.$$

A compositor can set 20 pages in $\frac{3}{5}$ of a day, another could set 20 pages in $\frac{2}{4}$ of a day, how long will it take the two men working together to do the work?

$$\frac{4}{3}+\frac{5}{2}=\frac{23}{6} \qquad \frac{23}{6}\text{ inverted } =\frac{6}{23}\text{ of a day.}$$

A cistern has 5 faucets; the first will fill it in 1 hour, the second in two, the third in 3, the fourth in 4, and the fifth in 5 hours; in what time will the cistern be filled, all the faucets running at once?

$$\frac{60+30+20+15+12}{60}=\frac{137}{60} \quad \frac{137}{60}\text{ inv.}=\frac{60}{137}\text{ of an h'r.}$$

A says to B, give me \$7 and I shall have as much money as you; B replies, give me \$7 and I shall have twice as much as you; how much money had each?

$7\times5=35 \quad 7\times7=49 \quad$ A \$35, B \$49.

How many different pairs can be made with 7 units?

$$\frac{7\times6}{2} = 21 \text{ pairs.}$$

How many bricks, $8\times4\times2$ inches, in a wall $160\times20\times2$ feet?

$$\frac{160\times20\times2\times3\times3\times6}{2\times1\times1}=172{,}800 \text{ bricks.}$$

How many shingles for a roof 60 ft. long, rafters 20 feet, two sides, shingles to show 6×4 inches.'

$$\frac{60\times20\times2\times2\times3}{1\times1}=14{,}400 \text{ shingles.}$$

If $21\frac{3}{4}$ bushels of oats will seed $9\frac{2}{3}$ acres, how many bushels will seed 100 acres?

$$\frac{87\times3\times100}{4\times29}=225 \text{ bushels.}$$

How many 16ths are there in .85?

$$\frac{.85\times16}{100}=13.6$$

$150 is due Jan. 1st., $78 is paid down, on July 1st., the account is settled by paying $78. What rate per cent is paid for the accomodation?

$$\$150—78=\$72.\ \frac{6\times2\times100}{72}=16\tfrac{2}{3} \text{ per cent.}$$

Find the value of an ounce of silver, gold being worth £3,,18,,7 per ounce, ratio $15\frac{1}{2}$ to 1. also 16 to 1.

£3,,18,,7 $\div 15\frac{1}{2}=60\frac{26}{31}$d. £3,,18,,7 $\div 16=58\frac{15}{16}$d.

What is the interest on 980 dollars for six days at 7 per cent. per annum?

```
980
 98
 49
-----
1.127
```

Ans. $1.127.